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Construction Methods

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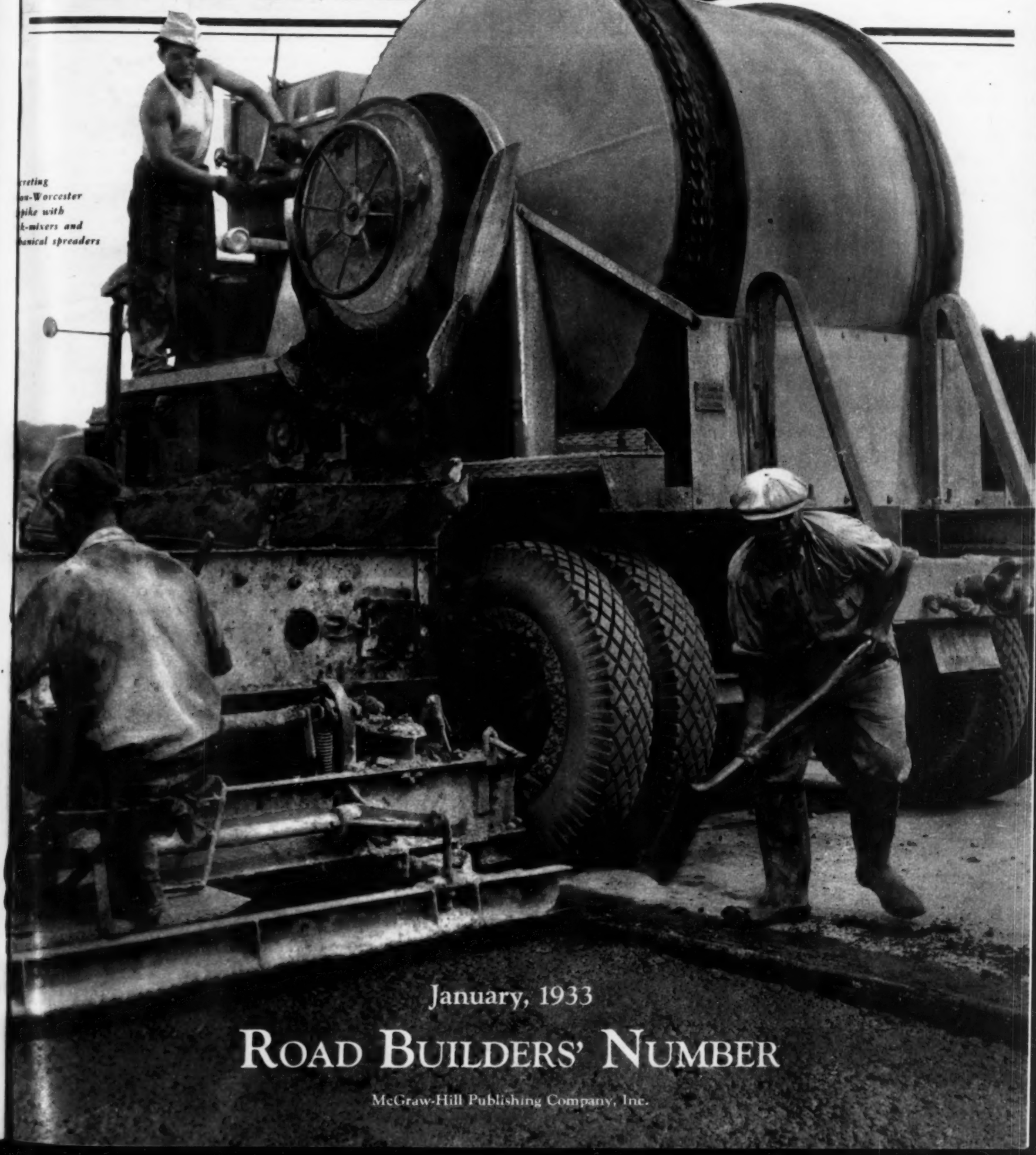


January, 1933

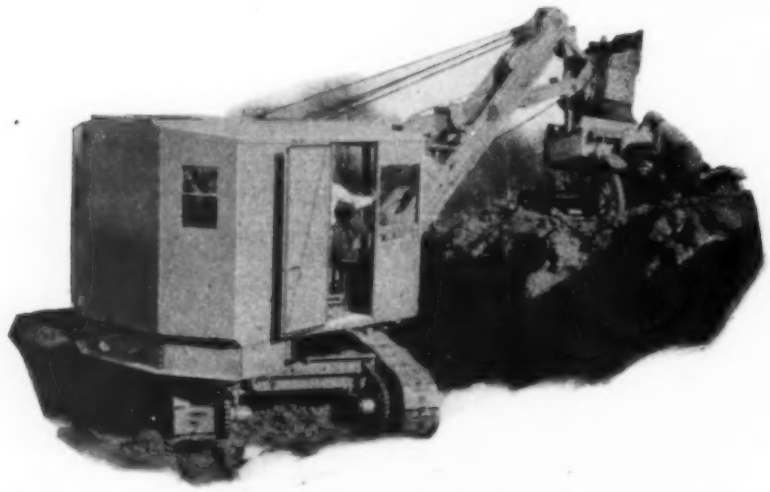
ROAD BUILDERS' NUMBER

McGraw-Hill Publishing Company, Inc.

/ R v. 15 1933

THE ENGINEER SAID:

"I never saw the old girl with so much pep and power"



—and of course he never had, for the "old girl" was the first gasolene shovel ever scientifically adjusted for maximum efficiency—the first to be Power Proved.

In the automotive field, the Power Prover is becoming a familiar story. Exhaust gas analysis has long been recognized as the only sure indication of the actual efficiency of internal combustion engines, but it remained for Cities Service engineers to bring the analyzing job out of the laboratory into the garage, through the development of the Cities Service Power Prover—*the only device which quickly and accurately analyzes exhaust gases and directly records the result in terms of per cent combustion.*

Supplementing the Power Prover is the Cities Service Tuning Routine—a system of making the precise adjustments required for really efficient performance, using precision tools developed by and exclusive with Cities Service. This combination, the Cities Service Power Prover and the Cities Service Tuning Routine, has improved performance and reduced by 10 to 25% fuel and maintenance costs of more than a hundred thousand motor vehicles, including thousands of trucks and buses.

Now, this same service is available for all heavy duty, gasolene-powered equipment—shovels, cranes, compressors, scrapers, tractors.

It isn't for sale—it's part of the service that Cities Service oil companies render to their patrons. There's no obligation either—our representatives will be glad to demonstrate *on your own equipment* just what the Power Prover can do for you in the way of economy and improved performance. If a 10 per cent cut in your gasolene bill is worth more than a three-cent stamp, write today to Cities Service Power Prover, Room 710, 60 Wall Street, New York.

CITIES SERVICE OILS — CITIES SERVICE — ALWAYS

Cities Service—*one of the country's ten largest industrial organizations*
—broadcasts Fridays, 8 P. M. (E. S. T.) over WEAF and 32 Stations.

CITIES SERVICE POWER PROVER

Cities Service Oil Company · Crew Levick Company · Cities Service Refining Company
Louisiana Oil Refining Corporation · A. R. Newcombe Oil Company

TECHNOLOGY DEPT.

Construction Methods

McGraw-Hill Publishing Company, Inc., 330 West 42nd St., New York

ROBERT K. TOMLIN, Editor

Editorial Staff: Vincent B. Smith, J. I. Ballard (San Francisco) John W. Shaver (Cleveland), Nelle Fitzgerald

WILLARD CHEVALIER, Publishing Director

The New "Construction Methods"

WITH this issue, CONSTRUCTION METHODS makes its bow, not in a new rôle, but upon a larger, better equipped stage and in a costume restyled to add distinctiveness and color to its performance. It continues in its part—first spoken 14 years ago—of picturing current construction practice in terms of improved methods, machinery and materials that help in planning and planting the job and doing the actual day's work.

The changes inaugurated this month involve a format approximately 40 per cent larger than heretofore—equivalent to 12 additional text pages per issue—a bolder, more readable type face, and, instead of letter-press printing, the use of rotogravure. This process is ideally suited to the reproduction of photographic illustrations which it has been this journal's policy to use profusely as a means of telling its story quickly and clearly to that group of methods-minded men, whether they be engineers or contractors, whose main responsibilities include the planning and organization of the work, decisions on plant setup, equipment and materials and direction of operations in the field. For the reader these innovations mean not merely a bigger paper, but a better paper.

The new paper is the result of an effort to give concrete expression to those principles of modernization that industry in general, seeing better times ahead, has been studying and applying to the redesign and improvement of its products and plants. Plans for the new paper were well developed more than a year ago, but conditions, then, did not appear favorable for putting them into effect. Now, at the threshold of a new year holding promise of an upward swing from the low levels of the past, we are confident in the belief that the time for action has arrived. With this issue, therefore, we ring up the curtain on the new CONSTRUCTION METHODS.

We hope you like the show.

NEW RIDGE ROAD in California, under construction by Morrison-Knudsen Co., involves unusually heavy mountain grading.

Highway and Building Congress

¶ Special significance attaches to the Highway and Building Congress which will be held in Detroit this month. In the past, the American Road Builders' Association has held its own annual convention and show. This year, however, that organization joins forces with thirty-three other participating and sponsoring groups in a combined meeting of national scope, representing all important branches of the construction industry. The main objective of the congress will be to consolidate action by the many diversified elements of the construction industry and to unite financial, contractual, engineering, material and equipment interests in a program of restoring highway and building construction to their normal proportions.

It has taken the construction industry a long time to marshall the forces of which it is constituted. The forthcoming Highway and Building Congress will have the opportunity to demonstrate, again, that "in union there is strength."

Annual Road Builders' Number

¶ In spite of last year's general curtailment of all construction work, road-building volume made an encouraging showing. Competition for contracts was keen, funds were limited, and the necessity for efficient methods and improved equipment to make the job yield a profit was never more apparent. Changes in types of construction and in construction technique had to be made to meet these new conditions.

In this, its annual Road Builders' Number, CONSTRUCTION METHODS presents typical examples of how highways were built under 1932 conditions. While there was a marked trend toward low-cost bituminous types and consequent improvements and refinements in this class of work, concrete paving practice yielded some highly interesting innovations in field methods and equipment. These took the form of attaining mass production by the use of fleets of large-capacity truck mixers, instead of pavers, and mechanical spreaders for distributing the concrete batches uniformly across the subgrade. Last year also saw a revival of the cement penetration type of construction for secondary roads at costs lower than are possible with standard slab concrete pavement.

State control over county and township roads is becoming more general, introducing new problems of administration and expanded organizations to handle the increased mileage for which the state forces become responsible.

In maintenance work, marked advances have been made in substituting permanent, white-cement traffic lines, built into the pavement, for the temporary painted lines generally used heretofore.

These and other topics are discussed in detail, from the point of view of the constructor, in the pages that follow. While the contents of this issue, appearing on the eve of the annual convention of the American Road Builders' Association, is devoted exclusively to highways, the methods and the equipment described can be applied directly or adapted with slight changes, to many other types of construction work.

A Look Ahead

¶ Pennsylvania's entry into the business of local-road improvement suggests a question of vital importance to highway builders. Will other densely populated states, as their primary systems approach a satisfactory degree of improvement, divert a substantial part of their highway funds from high-type to low-type construction. If such diversion is made, will the contractor with present organization, equipment and methods, be ready to execute low-cost construction at a profit?

It is reasonable to expect that, with trunk systems of adequate design approaching completion, the states are going to give greater attention to secondary roads, now mainly under the jurisdiction of counties and townships. The trend toward amalgamation and centralized control of all roads in a state has made itself increasingly evident in the last few years. North Carolina and Virginia, which have absorbed all roads into the state systems, are outstanding examples of this change in highway administration, while Indiana, Tennessee and Michigan, as well as Pennsylvania, are moving in the same direction. To the road builder, this inevitable drift means an increasing expenditure for low-type pavement, with consequent curtailment of high-type construction.

If contractors are to cope successfully with the new conditions they must realize that changes will be necessary in their organization and equipment. The changes can and will be made, to the eventual profit of both the states and the contractors.

Construction Methods was founded in 1919, under the name *Successful Methods*, by the Manufacturers Publicity Bureau, Inc., of Chicago, representing a group of non-competing manufacturers of construction equipment. Charles B. Thomas, editor of the first few issues, was succeeded by William Jabine.

In 1926 the McGraw-Hill Publishing Company, Inc., of New York, purchased the publication, changing its name to *Successful Construction Methods* in November of that year and to *Construction Methods* in May, 1927, in order more accurately to define its field and purpose.

Robert K. Tomlin was appointed editor of *Construction Methods* in January, 1928. Vincent B. Smith, J. I. Ballard (San Francisco) and John W. Shaver (Cleveland) are assistant editors and Nelle Fitzgerald editorial assistant.

To Speed the Flow of Ideas

IN READING Mr. Locher's article, which appears in this issue,you will be interested in his closing paragraph. He says in part:

> "Years of well-seasoned experience are valuable, good judgment is fine, but unless experience and judgment are kept fresh by information on the latest developments in equipment and methods, you are soon outbid by those who do keep posted."

To us, this is most stimulating, for *Construction Methods* is founded upon the proposition that the progress of any industry depends chiefly on the widespread exchange of ideas, knowledge and experience.

When a manufacturer of construction materials or equipment develops a better material, designs more efficient equipment, produces at lower cost, or provides more convenient and trustworthy service through his distributing agencies, he has something to contribute to construction practice. When the individual constructor contrives to plan and conduct his field operations more efficiently, he, too, is in position to advance the progress of his craft.

But until a substantial part of the men engaged in a field know of each others' work, there cannot be that general increase in efficiency which expands the markets and the earnings of both constructor and manufacturer. Ideas, experience, knowledge—these, indeed, are the currency of progress, but as with all currency, it is their circulation that is essential to the general welfare. Without this they are as fruitless as the miser's hoard.

So *Construction Methods* is a clearing house for ideas, and our duty is to facilitate their flow. Through the reading pages we must help the constructors to exchange experience and acquaint the manufacturers with the constructor's problems and needs. Through the advertising pages we must bring the constructors to meet the manufacturers so that they may learn what materials and tools are available for their use. Thus, while we stimulate the interchange of mutually helpful knowledge, we provide also a show-window, where the manufacturer may display and demonstrate his wares to a vast market at low cost.

In keeping with the current need for more efficient performance, it is our wish to make *Construction Methods* even more helpful in this respect than it has been. Hence the new form, first embodied in this issue. Striking though the physical change may be, it implies no change in purpose and substance. The currency remains unchanged; through improved form we seek only to increase our efficiency as a clearing-house.

To the reader we offer a larger page and a more flexible printing process, giving the editor a chance to produce a more readable and helpful paper. But of that he will tell you in more detail on his own page.

To the advertiser, also, we offer a larger page with a corresponding opportunity for more impressive display, a new printing process designed to facilitate the use of illustrations, an enhanced reader interest and, in general, a more effective vehicle by which to carry his story to those who should use his products.

By this change, then, we increase our capacity to "refresh well-seasoned experience and good judgment by information on the latest developments in equipment and methods."

Willard Chevalier

Publishing Director

In This Issue:

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Placing the cleavage fabric used in Sheet Concrete Construction on Federal Aid Project No. 211-C Boston-Worcester Turnpike, Framington, Mass.

Jericho Turnpike, Mineola, N. Y., Long Island's heaviest traffic artery is paved with Sheet Concrete.

The five-year development period of Sheet Concrete *pavement proves conclusively the outstanding success of this new type paving.*

Better than a million yards of Sheet Concrete *pavement have been laid and proved successful in service. More than a hundred road jobs have been laid with* Sheet Concrete *ranging from heavy traffic on important state highways to the lesser travelled residential streets.*

Experience proves that possibilities are opened up for aggressive contractors to increase profits, yardage and to speed up work without adding to labor overhead.

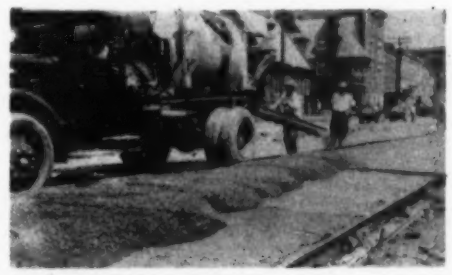
For example: .... on a New York State Highway, a contractor averaged 1300 feet per day with ordinary concrete process and stepped up to 1700 feet per day with *Sheet Concrete*—a yardage increase of approximately 30% with a payroll increase of less than 10%.

.... on a city job, *Sheet Concrete* enabled the use of local aggregates in the base course which resulted in a saving of nearly 40% in the cost of materials for the complete job.

.... on several jobs, the use of truck mixers for the top course concrete has not only increased the contractors' daily production but has enlarged the market for ready mixed concrete plants.

These examples, picked at random from many actual experiences, point to many other possibilities for greater profits for *Sheet Concrete* licensees.

Yet this *better* pavement, using modern construction methods, costs no more than ordinary types. It has the strength and sturdiness of reinforced concrete, the durability of granite blocks and the removability and repairability of sheet asphalt surface. It combines the good points of every other type pavement and eliminates the undesirable features.



Truck mixer delivering fine aggregate mix top course for Sheet Concrete Pavement on Boston Post Road at Mamaroneck, N. Y. Base paver in background.

Proved in Service where conditions were toughest

The north-eastern states with their severe climatic conditions and the heaviest traffic in the world, were selected as the proving ground for *Sheet Concrete* pavement. Its satisfactory service under these conditions insures the same kind of service anywhere in the western hemisphere.

An opportunity awaits alert contractors to secure territorial licenses

Territorial licenses are now available in many sections of the United States and Canada. Present day efficiency, faster production, and no increase in overhead are new opportunities offered contractors and other licensees by the *Sheet Concrete* method of paving construction. Qualified representatives can turn these opportunities into worthwhile profits.

Use the coupon below in asking for further information.

Sheet Concrete Pavement Corp. of America
51 East 42nd Street, New York, N. Y.

Gentlemen:

Please send me (1) your illustrated booklet showing Sheet Concrete road jobs all over the country (2) technical information (3) your licensee proposition.

Name .....

Company .....

Address .....

SHEET CONCRETE PAVEMENT CORP. *of* AMERICA

51 E. 42nd Street NEW YORK CITY . . . N. Y.

"The most ubiquitous equipment at Hoover Dam"

WRITES SIX COMPANIES, INC.

FOURTEEN versatile "Caterpillar" Tractors hustle along important construction details for the builders of Hoover Dam. Their power, stamina, and traction come in handy at bulldozing shelves along rocky grades. They maneuver nimbly in close quarters to move and spot heavy equipment. They reach over cliffs with hoist and cable to transfer loads quickly and cheaply. After a flood, their broad, sure-treading tracks walked right over the silt and trash. And they speedily cleared away the debris from a diversion tunnel to save important time and money! "Equipped with a variety of appliances and apparatus and doing a multitude of jobs, 'Caterpillar' Tractors are undoubtedly the most ubiquitous equipment here," writes Six Companies, Inc.!

Caterpillar Tractor Co., Peoria, Ill., U. S. A.

Track-type Tractors Combines Road Machinery

(There's a "Caterpillar" Dealer Near You)

Prices—f. o. b. Peoria, Illinois

FIFTEEN	$1100	THIRTY-FIVE	$2400
TWENTY	$1450	FIFTY	$3675
TWENTY-FIVE	$1900	SIXTY-FIVE	$3850
DIESEL	$6500		

CATERPILLAR

REG. U. S. PAT. OFF.

TRACTOR

Buy modern models for modern jobs!

In the trying years just passed, few manufacturers have had the courage and substantial resources necessary for developing machines required by the new standards of low cost output. Check therefore, before you buy an excavator, to be sure that your selection is really up-to-date . . . not just an obsolete design with a different coat of paint or an old machine slightly revamped to take a bigger bucket and a new model number. You are paying for an up-to-date machine . . . be sure you get it.

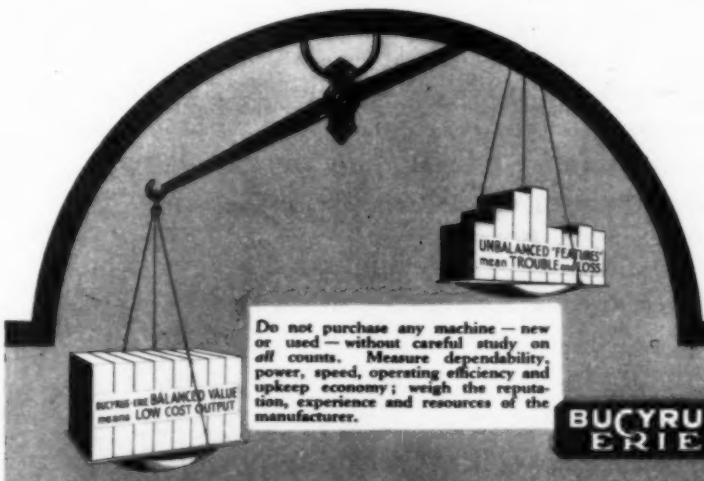
Since 1929, Bucyrus-Erie has developed and proved in actual field operations, a complete new line of contractors' shovels. draglines and cranes. Each embodies the latest engineering development.

Consider the factor of modern design as you check each machine for balanced value. Be sure to see Bucyrus-Erie before you buy.

BUCYRUS-ERIE COMPANY
South Milwaukee, Wisconsin

574

All Sizes—½ yd. to 18 yds.
Shovels : Draglines : Dragshovels : Cranes : Clamshells : Dredges : Tower Excavators : Tunnel Shovels : "Loadmaster" Cranes : Bucyrus-Monighan Walking Draglines.
Gasoline : Diesel : Electricity Gas+Air : Steam.
Dragline Buckets

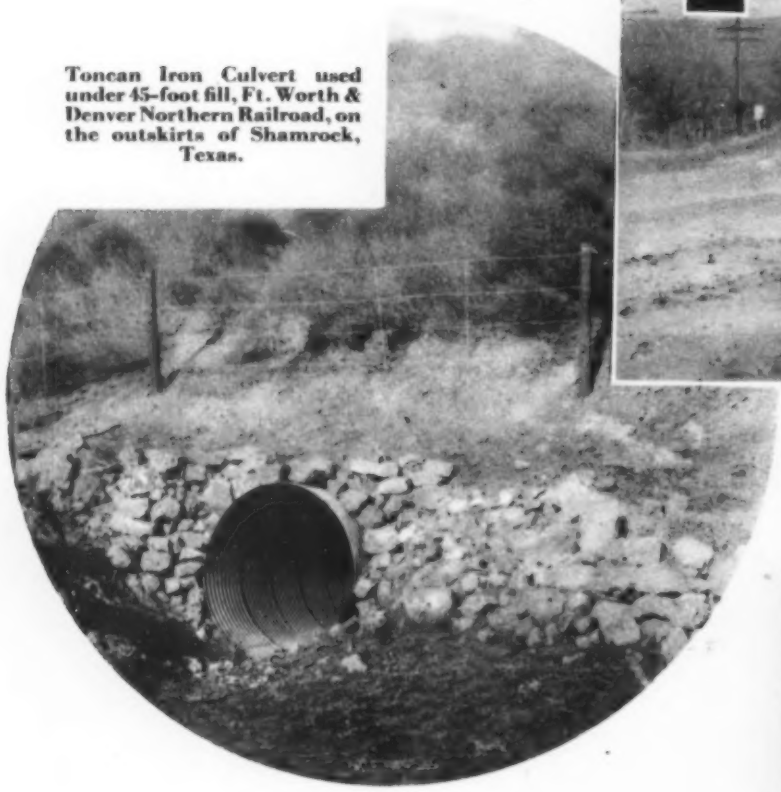


Do not purchase any machine — new or used — without careful study on *all* counts. Measure dependability, power, speed, operating efficiency and upkeep economy; weigh the reputation, experience and resources of the manufacturer.

BUCYRUS ERIE

SEE BUCYRUS-ERIE BEFORE YOU BUY!

CONSTRUCTION AIDS FOR 1933



Toncan Iron Culvert used under 45-foot fill, Ft. Worth & Denver Northern Railroad, on the outskirts of Shamrock, Texas.

ABOVE—Tyton Highway Guard of Toncan Iron, installed by Kansas State Highway Dept. near Lawrence, Kansas.

BELOW—Completing 225 feet of 90-inch diameter Toncan Iron Sectional Culvert near Hayts Corners, N. Y.

Three aids to construction are offered by the Toncan Culvert Manufacturers' Association as a means toward greater economy and better construction work.

Toncan Iron, the long-lasting alloy of refined iron, copper and molybdenum makes this possible through its resistance to rust—a resistance surpassed in the field of ferrous metals only by the stainless irons and steels.

Toncan Iron Plain and Perforated Culverts are made in diameters 8 to 84 inches in gauges 16 to 8, and with a full line of fittings adapting them to all conditions of service.

Toncan Iron Sectional Culverts are made in diameters 60 inches to 150 inches and in gauges 7, 5, 3 and 1 to meet service conditions. They are shipped in curved sections and bolted together in the field. Special bolts save time and labor in construction.

The Tyton Highway Guard is the last word in highway protection. A plain or corrugated metal sheet supported by a spring deflects the vehicle striking it and guides it along the guard until control is regained. The construction is staunch yet simple. Erection is quick and requires only common labor. The deflecting panel may be Toncan Iron or special spring steel if desired.

Write for additional information on the product or products in which you are interested.

REG. U.S. PAT. OFF.
TONCAN
COPPER
MO-LYB-DEN-UM
IRON

TONCAN CULVERT MANUFACTURERS' ASSOCIATION
YOUNGSTOWN, OHIO

Consider Its Record!

After all is said and done—results are what count, and that is why we ask you to consider the actual service record of "HERCULES" (Red-Strand) Wire Rope.

"HERCULES" is economical because it is extra long lasting, and its long life is not a matter of chance or guess but the result of definite and specific causes—developed by us during our seventy-five years of rope making.

Another important factor is that "HERCULES" (Red-Strand) Wire Rope is made in a wide range of constructions. If you will tell us how you use wire rope, we shall be glad to suggest the type we consider best for your particular work.

Made Only By

A. Leschen & Sons Rope Co.

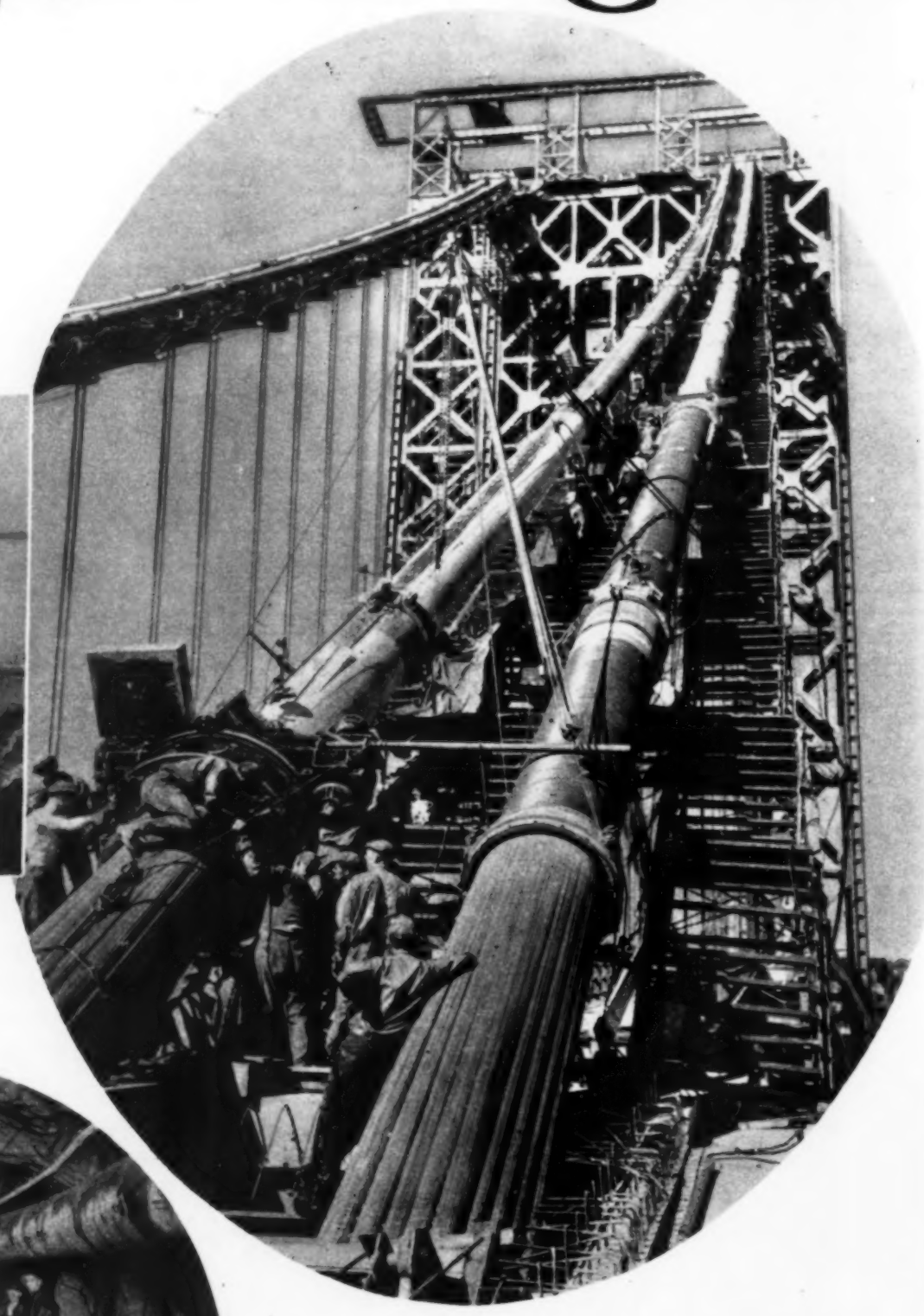
Established 1857

5909 Kennerly Avenue - - - St. Louis, Mo.

New York - - - - - - - - - 87 to 90 West Street
Chicago - - - - - - - - 810 W. Washington Blvd.
Denver - - - - - - - - - - 1554 Wazee Street
San Francisco - - - - - - - - - 520 Fourth Street

G-E Equipment Cuts

AT OSAGE DAM IN MISSOURI
From the first cuts of the dredge and draglines, until the last sluiceway was closed, General Electric equipment played an important role in the completion of this huge project well ahead of schedule—saving time and money for the builders at every stage of the job



GAUNTLETS ON MIGHTY ARMS OF CABLE
After the cable-wrapper, motorized by General Electric, finished winding on a protective wrapper of wire, the great cables of the George Washington bridge were ready for their duty of supporting the world's largest suspension bridge

IN THE CASCADE TUNNEL
G-E locomotives mastered abnormally difficult service conditions. Quoting the general superintendent of this project: "During the entire period of construction, covering about three years, the 42 G-E mine-type locomotives performed most satisfactorily under perhaps some of the worst conditions of water and service to be found in tunnel construction."

GENERAL

CONSTRUCTION COSTS

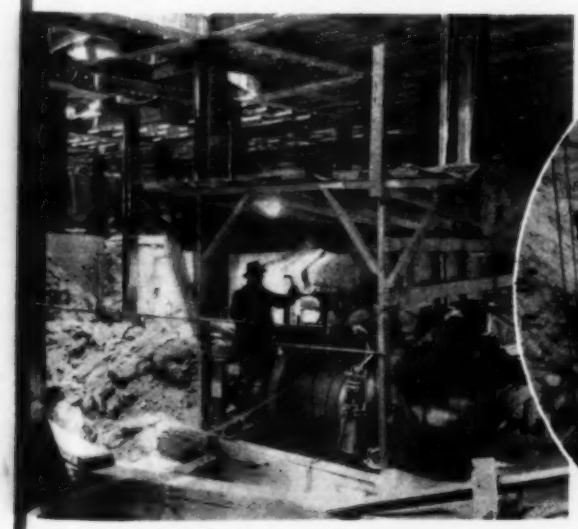
FROM the time ground is broken in any project, great or small, until the job is successfully completed, General Electric equipment can do much to keep down construction costs—a fact attested by the many contractors who have used motors, control, and other electric equipment manufactured by General Electric.

Before you buy any electric equipment, consider these factors of G-E service: engineering help when it is needed; prompt manufacturing and shipping coöperation when time is precious; immediate stock shipments from conveniently located warehouses when standard supplies are desired quickly; a nation-wide chain of service shops; highly trained specialists with whom to deal in every transaction—all to help you keep the job moving profitably. General Electric Company, Schenectady, N. Y.

MAINTAINING A CHANNEL OF COMMERCE
General Electric equipment supplies the tremendous power behind the dredging machinery of this great dipper dredge shown at work on the Hudson river

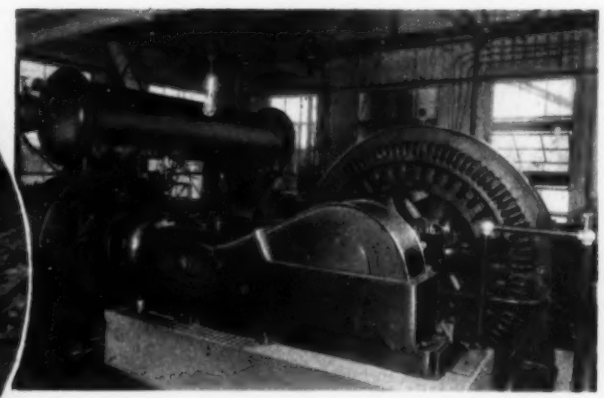
THE ATTACK ON DENNY HILL
"Wipe out Denny Hill!" commanded Seattle. "It is blocking the expansion of our business district." G-E equipment was selected for the five power shovels and the 32 portable conveyors; again its record is one of satisfaction

CONQUERING THE TURBULENT OWYHEE RIVER
G-E motors and control dependably operated the crushers and screens that prepared the aggregates; the mixers; the compressors that forced air into the rock drills; the great aerial tramway (shown here); and other important apparatus that made possible the reclaiming of 125,000 acres of arid land in Oregon and Idaho



SERVING A "SKY-LINE" ARMY
Daily, from the laying of the cornerstone to the anchoring of the great steel pylon that tops the structure, G-E motors and control operated the fast, powerful hoists used in erecting the Empire State Building in New York. How G-E equipment served the "sky-line" army of Empire State is construction history

RIVER DES PERES RIDES THE SUBWAY
St. Louis turned this civic nuisance into an engineering triumph, with the aid of G-E motors and control that powered the unique materials-handling tower and other apparatus



UNDER THE SIDEWALKS OF NEW YORK
Six- and often eight-hundred feet below the canyons of Greater New York, below the boroughs of Bronx, Queens, and Brooklyn, under the East River at Riker's Island, runs City Tunnel No. 2. Under ground, 62 powerful G-E storage-battery locomotives contributed their bit. Sixteen G-E 400-hp. synchronous motors driving air compressors, sixteen G-E 250-hp. motors driving the hoists, and other equipment of G-E manufacture were in service here

200-675

ELECTRIC

GOODBYE, PAVERS

JAEGER Introduces "MILE-A-DAY" Production for BIG Jobs, New Efficiency for the SMALLEST!

(1 to 6 Lane Pavements – Widening – Shoulders – Bridges – Aprons
All Handled with Road Builder Truck Mixers and Spreaders)

Capable of mile-a-day production, yet equally adapted for smallest paving jobs, plus widening, shoulder work, bridges, culverts and aprons, the Jaeger Paving Plant and Method now reduce paving to a matter of transportation in which drier, higher strength mixes of concrete are more workable than the wet mixes of former days.

YOU NEED LESS PLANT because you can throw off [illegible] Road Builder Truck Mixers [illegible] the same chassis, load [illegible] the same [illegible] and [illegible]. YOU WASTE NO TIME [illegible]

[illegible] LINEAL FEET [illegible] DAY [illegible]

[illegible] HANDLING [illegible]

HIGHER STRENGTH CONCRETE [illegible] drier, more workable, [illegible] concrete.

[illegible] batches [illegible] and can [illegible] spread and [illegible] off [illegible] YOU GAIN [illegible] uniform consistency, [illegible] and final strength in the finished slab.

Popular Priced Small Plants

Road Builder Truck Mixers [illegible] cu. yd. capacities, with spreaders for [illegible] paving and widening, and have been [illegible] used on [illegible] to [illegible],000 [illegible] widening, bridges, aprons, [illegible]

MAIL TODAY to THE JAEGER MACHINE CO. [illegible]

[illegible]

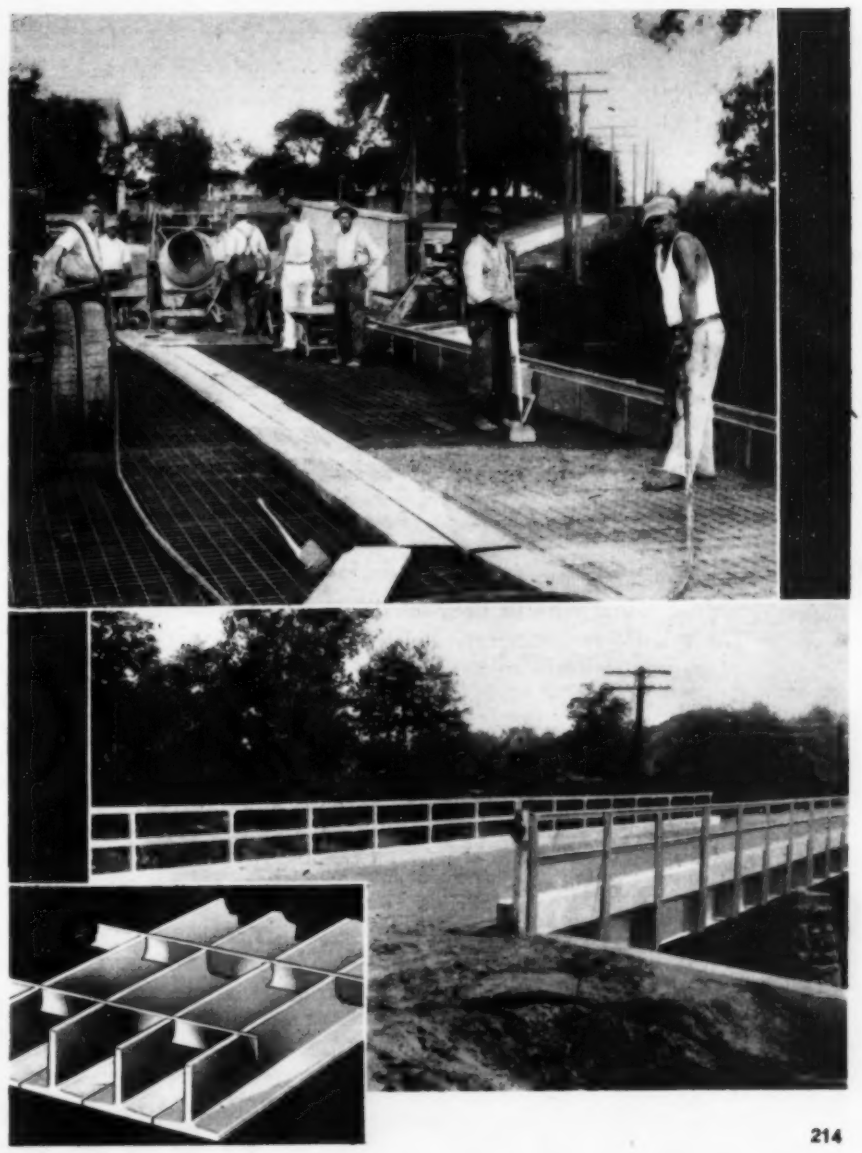
NEW HIGH SPEED FINISHERS — SUBGRADERS — ROAD and DRAINAGE PUMPS — BRIDGE MIXERS

Are you looking

for better methods of bridge floor construction?

T-TRI-LOK merits your investigation. **T-TRI-LOK** provides an armored concrete, anti-skid wearing surface of long life and high efficiency. As soon as the panels of **T-TRI-LOK** have been secured to the bridge stringers, trucks, concrete mixers and other equipment can be driven right onto the bridge floor. It is not necessary to build temporary floors or devise other complicated means of delivering concrete to the job. This immediate use of the floor is a worth while item of economy and convenience.

Competent engineering service is at your call.



Carnegie Steel Company · Pittsburgh

Subsidiary of United States Steel Corporation

214

T · TRI · LOK

WILL YOUR HIGHWAYS *be* SAFE FOR DRIVING THIS WINTER?

32 DEAD, 312 INJURED
222 Accidents in 14 States

Disastrous Fourteen Day Record of Icy Roads and Streets

From Feb. 5th to 19th icy roads caused 222 accidents in 14 states affecting seriously such states as Michigan, Kansas, Missouri, New York, Pennsylvania, Iowa, Mass., Nebraska, North Dakota. How many of these fatal accidents could have been prevented is a matter now engaging the serious thought of highway officials.

THE surest way to prevent death and to avoid destruction of property on icy highways is to prepare for ice control before winter comes. Even States bordering the snowless regions of the south suffered severely in the very mild winter of 1931. The death list was high.

Sand or other gritty material embedded in the icy surface prevents skidding. Piles of sand or cinders, built up with alternate layers of Calcium Chloride, can be provided at strategic locations, ready for spreading when icy conditions warrant.

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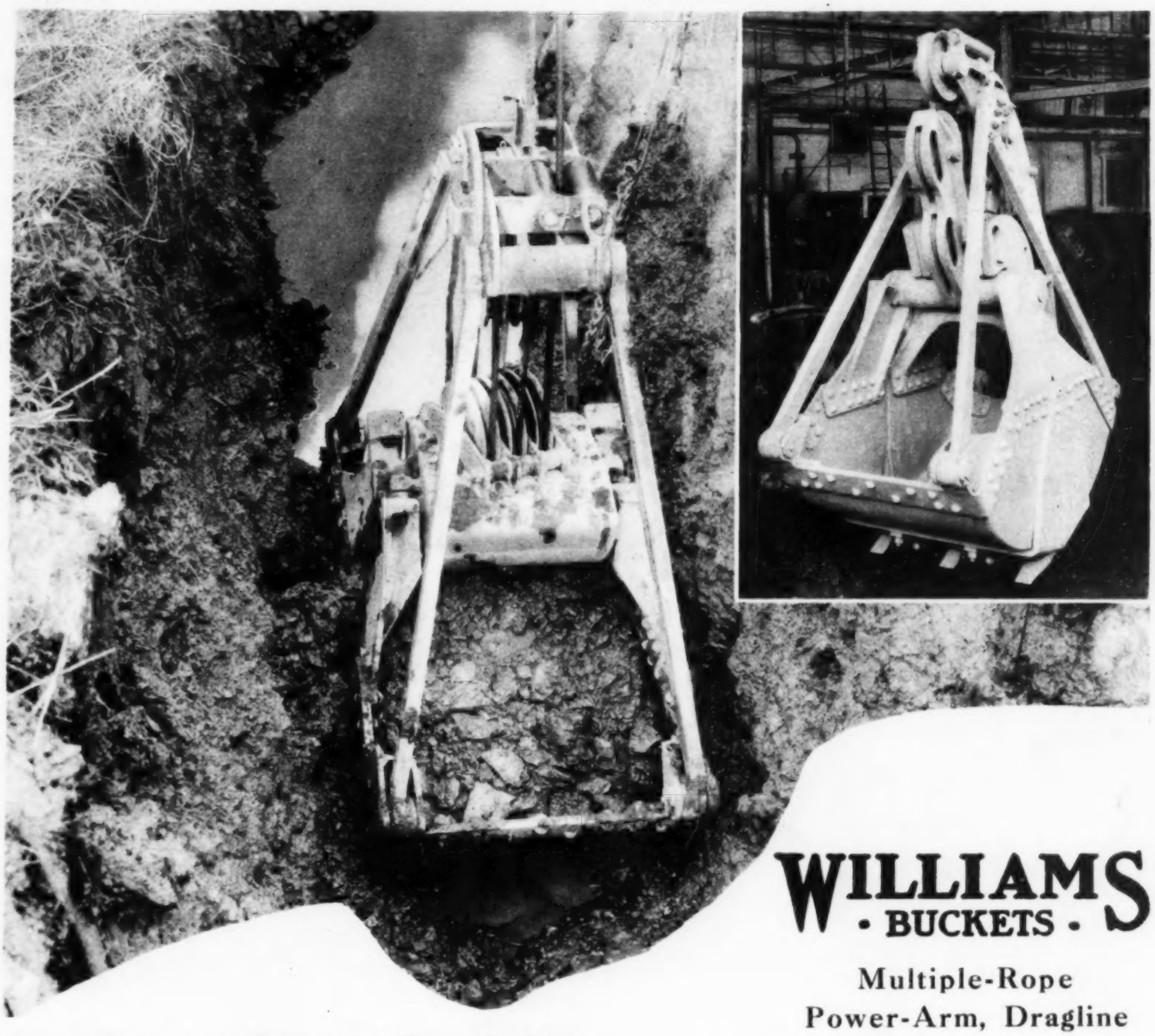

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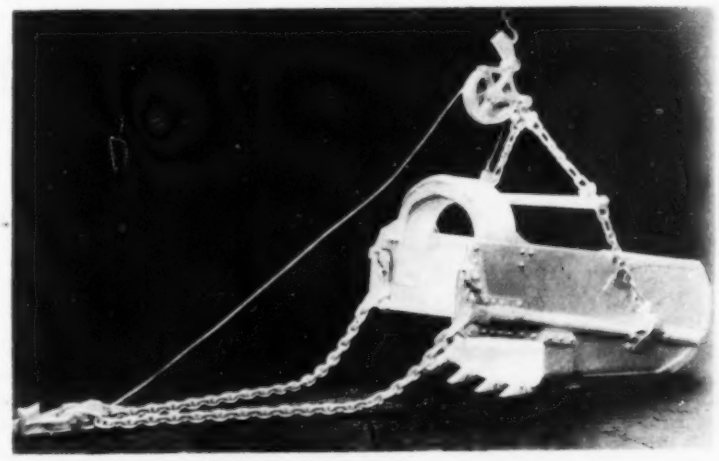

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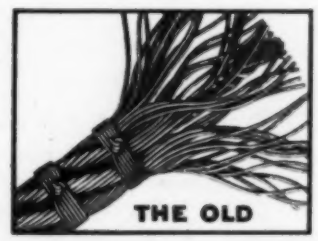

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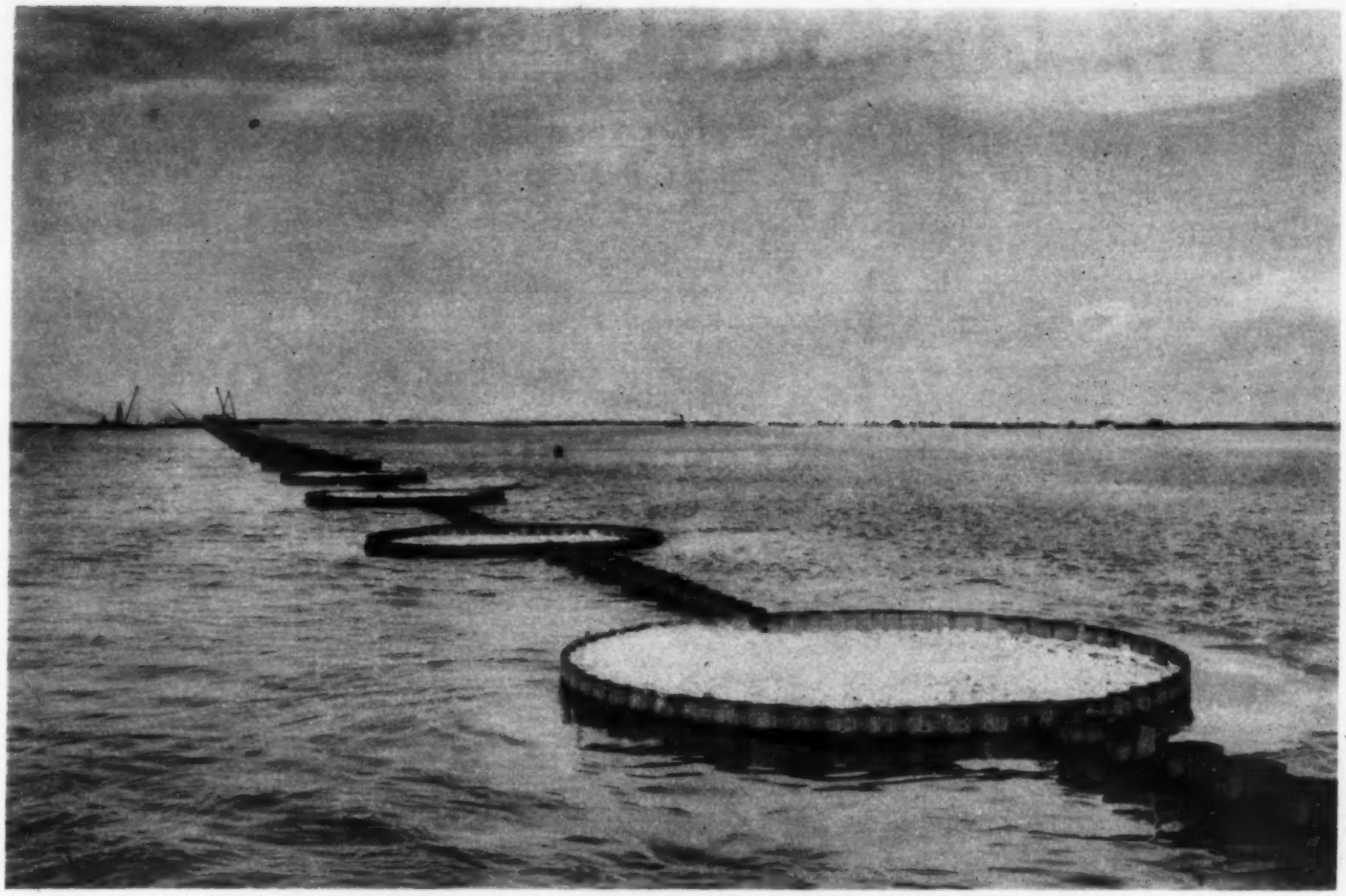
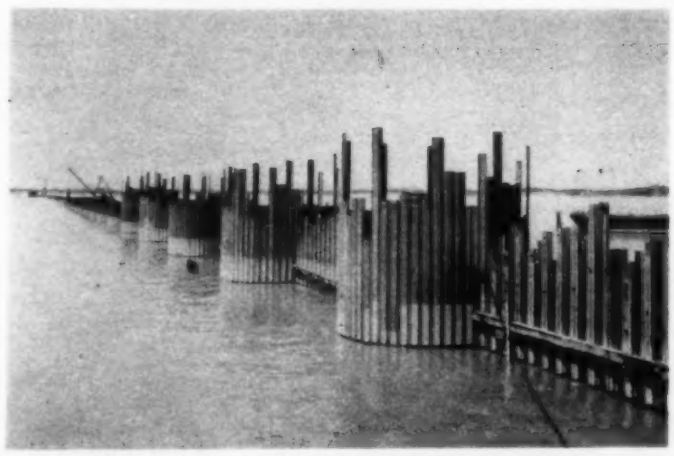


3300-ft. Dike Extension built of BETHLEHEM (Lackawanna) PILING



Bethlehem (Lackawanna) Section AP 16 is used in the cylinders; Section DP 165 is used in the straight portions of the Dike. Every sixth pile is 60 ft. long; the others are 40 ft. long. The cylinders, filled with sand and gravel, will be topped with stone.

War Department, U. S. Engineer Office, Philadelphia
Triest and Earle, Inc., Philadelphia, Contractors

Pea Patch Island Dike is designed to prevent shoaling of the Delaware River channel along the sharp bend north of Pea Patch Island, near New Castle, Del. A 3300-ft. extension of this dike is now being built of Bethlehem (Lackawanna) Steel Sheet Piling, involving the use of approximately 3000 tons.

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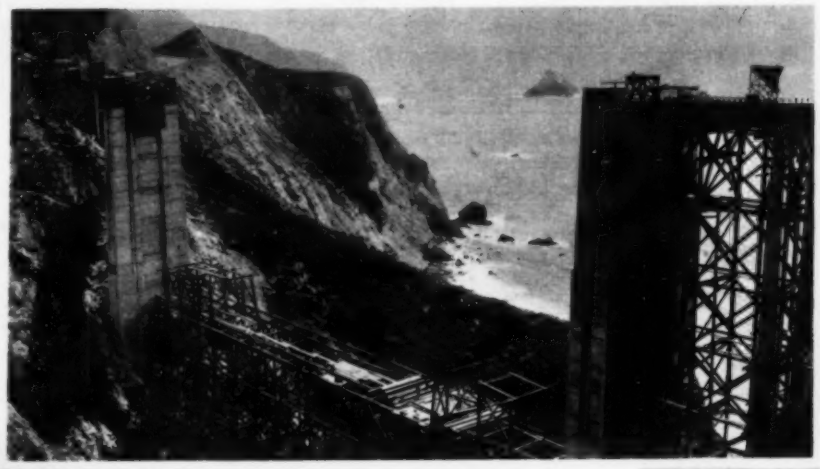
Construction Methods

Established 1919—McGraw-Hill Publishing Company, Inc. ROBERT K. TOMLIN, Editor Volume 15—Number 1—New York, January, 1933

TIMBER FALSEWORK

260 Ft. High, Carries Concrete Highway Bridge During Construction

OF TWO possible locations for the Bixby Creek crossing of the Carmel-San Simeon highway along the rugged Monterey coast in California, connecting at San Luis Obispo with the main San Francisco—Los Angeles route, the division of highways chose a line requiring a 342-ft. bridge spanning between bluffs at the creek mouth, where a magnificent view of shore and ocean is offered to the traveler. The bridge constructed at this site is the longest reinforced-concrete arch in the state.



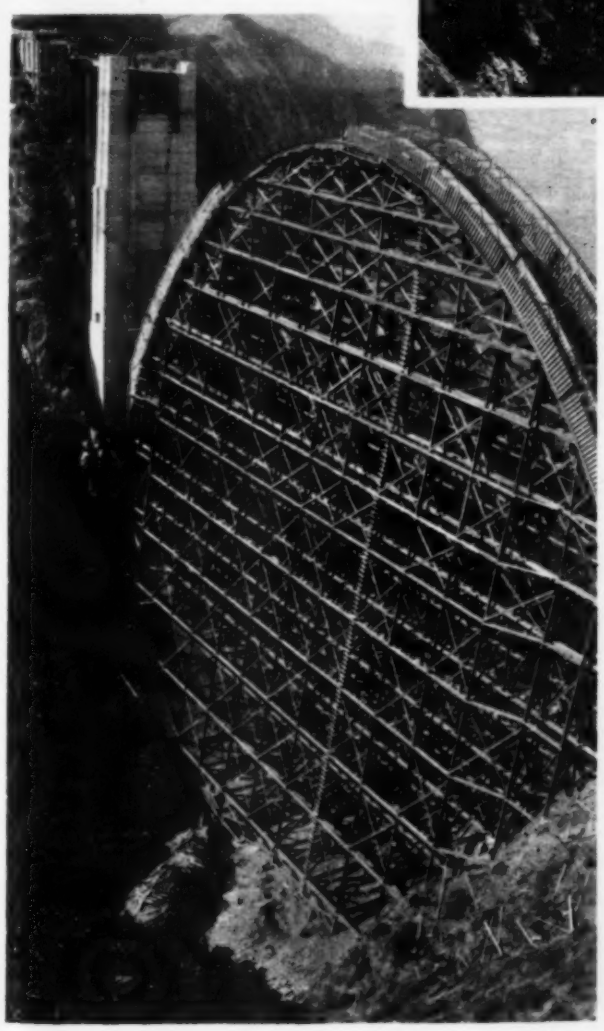
WHERE BIXBY CREEK FLOWS INTO PACIFIC OCEAN, contractor erects high timber falsework for concrete arch and nine deck girder approach spans.

Three 40-ft. deck-girder approach spans at the south end and six similar spans at the north end increase the total length to 714 ft. The structure carries a 24-ft. clear roadway 260 ft. above the creek.

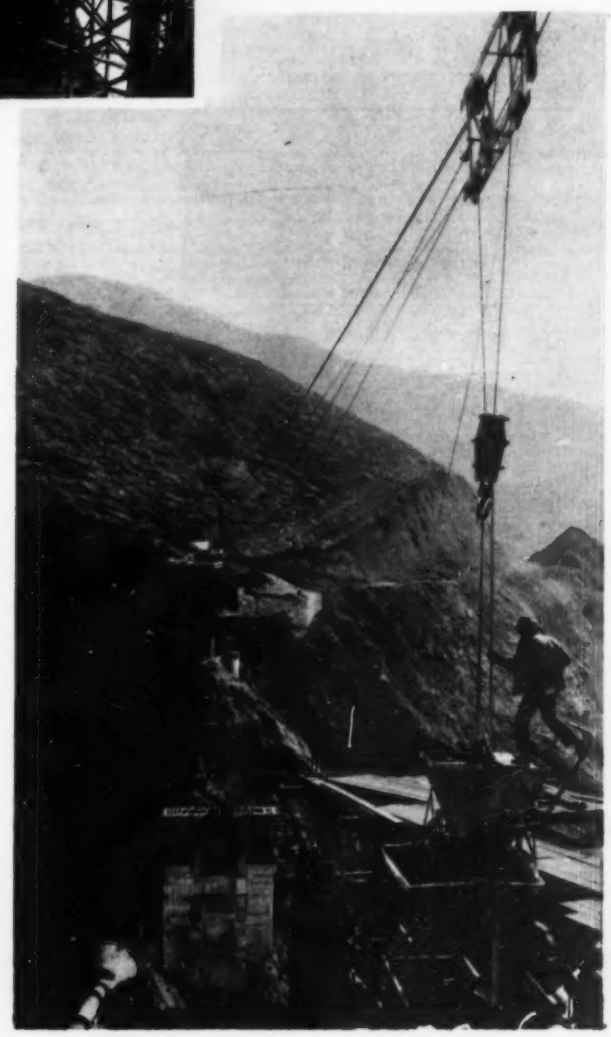
Contractors were required to submit bids on two methods of construction, one calling for conventional timber falsework, and the alternative providing structural steel-arch ribs which would support the forms and later act as reinforcing when encased in concrete. The state agreed to accept the lowest bid, regardless of which alternative was lowest, and the contract was awarded to the Ward Engineering Co., of San Francisco for a bid price of $203,334 on the falsework method.

Construction required 4,700 yd. of excavation, 6,600 yd. of concrete (860 yd. of which was in the arch ribs), and 300 tons of reinforcing steel. Concrete abutments resting on rock rise to a height of 120 ft. from the precipitous canyon slopes 140 ft. above the stream. A high timber falsework structure was raised by tiers between the abutments, exposure to strong winds from the ocean making this work unusually difficult. The concrete arch ribs constructed on the falsework were 4½ ft. wide, 5 ft. deep at the crown, and 9 ft. deep at the springing line.

A high-line rope tramway, 300 ft. above the creek, delivered men, equipment and materials to all parts of the bridge during construction. I. O. Jahlstrom was resident engineer in charge for the division of highways of the state department of public works.



RIB FORMS for 330-ft. clear arch span are erected on tall timber falsework.



ROPE TRAMWAY, 300 ft. above stream, delivers concrete to deck hopper on approach span.

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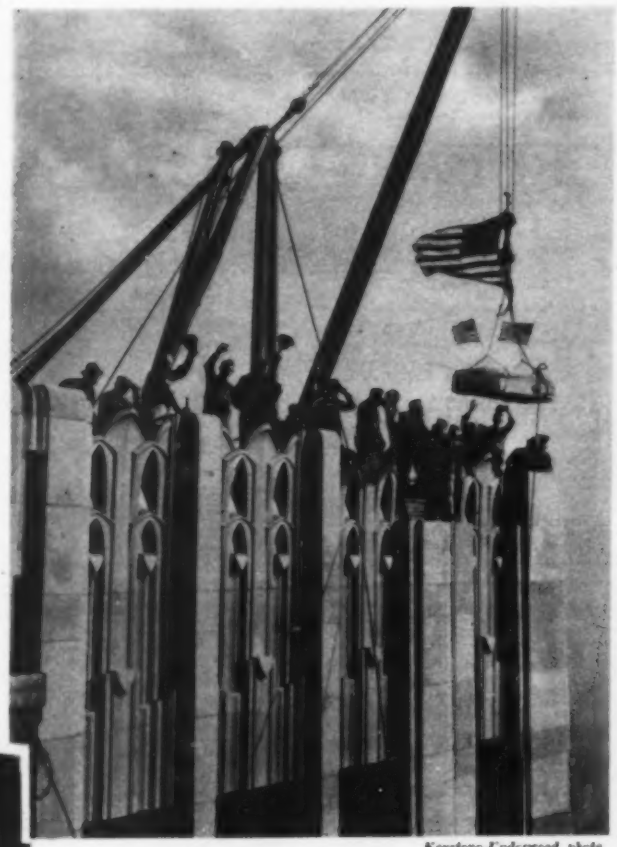


Keystone-Underwood photo

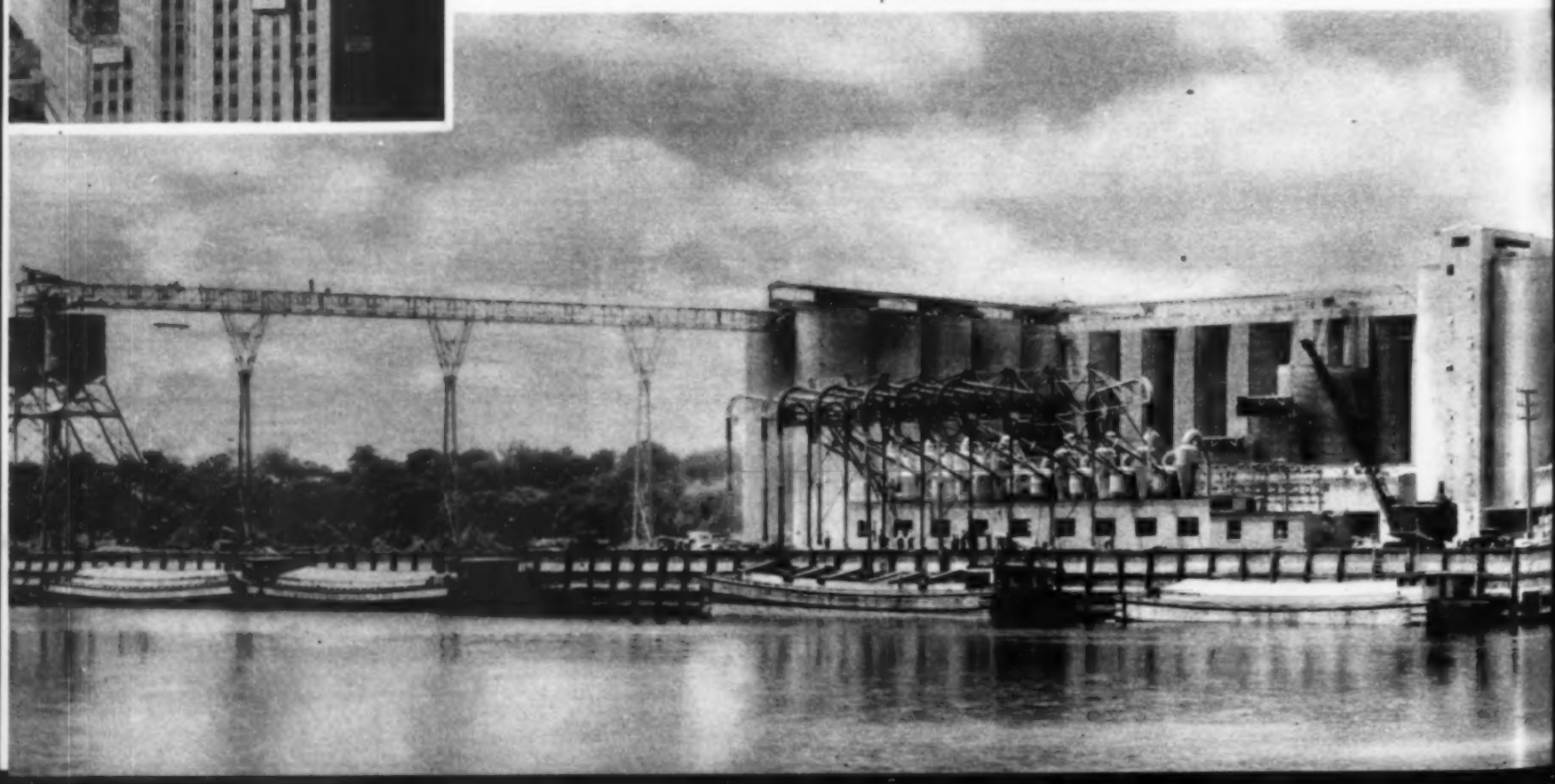
ROCKEFELLER CENTER, comprising a three-block, $250,000,000 building group in mid-town New York, adds a new 69-story structure to Manhattan's skyscrapers. R. C. A. building *(at left)* is 832 ft. tall and has 2,000,000 sq. ft. of rentable floor space. Last stone *(above)* was set Dec. 7 by forces of Hegeman-Harris Co., contractor.

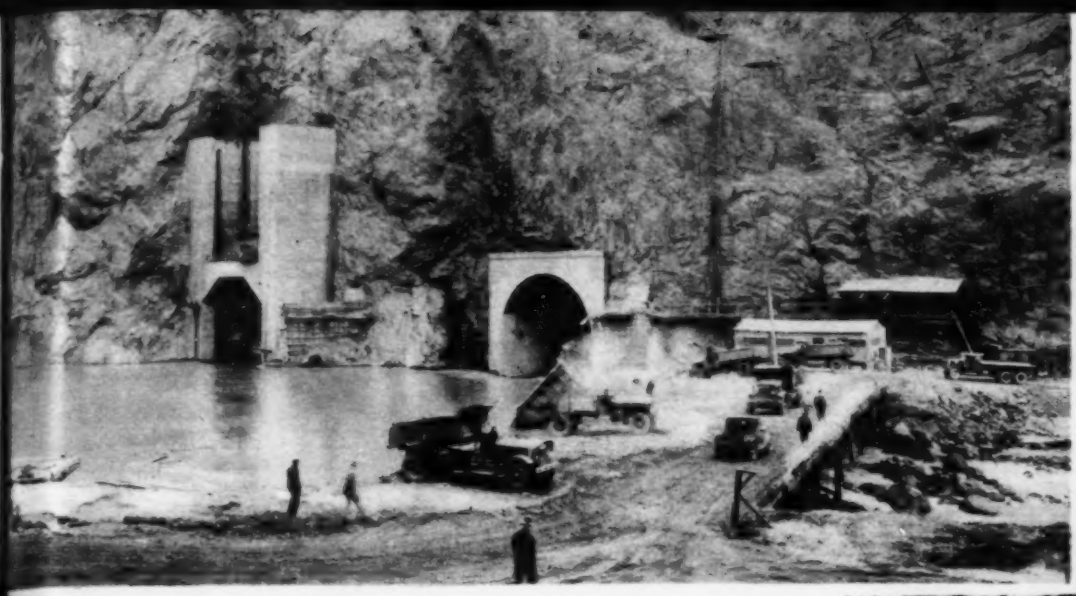
BIG CONTRACT SIGNED. William P. Filmer, at left, president of Golden Gate Bridge District, San Francisco, closes $5,855,000 agreement for cables of suspension structure with F. W. Hammond, president of John A. Roebling's Sons Co. Total cost of bridge will be $24,000,000.

Wide World photo

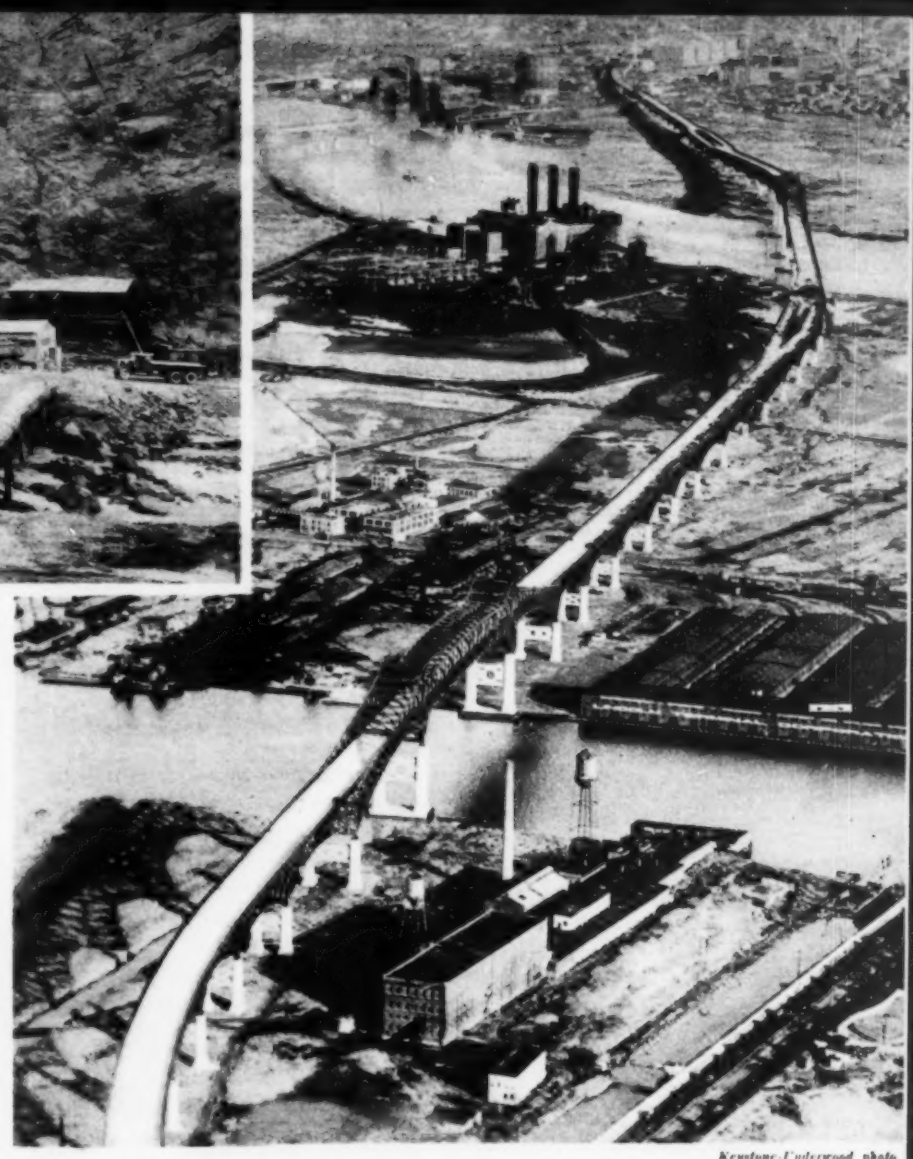
BRICK PAVING carries traffic over recently completed George Westinghouse bridge, near Pittsburgh. Structure of five concrete-arch spans was built by Booth & Flinn Co. for the Department of Highways of Allegheny County.

NEW GRAIN ELEVATOR *(below)* with 13,000,000-bu. capacity, has been built by James Stewart Corp., contractor, of Chicago, for Albany, (N. Y.) Port District Commission. Project includes 120 circular concrete bins and storage area covered by curved roof of suspended steel sheets, welded together.



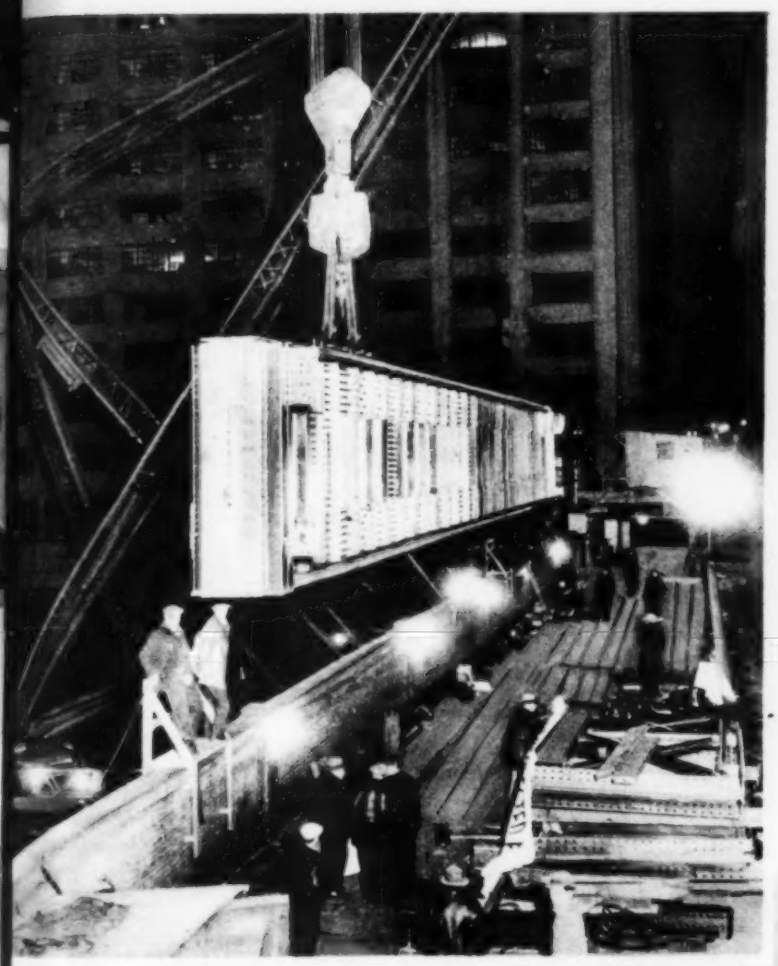


COLORADO RIVER DIVERTED. Preparatory to building of Hoover dam, Six Companies Inc., contractors, bypass flow of stream around damsite through 50-ft. diameter concrete-lined tunnels in canyon walls.



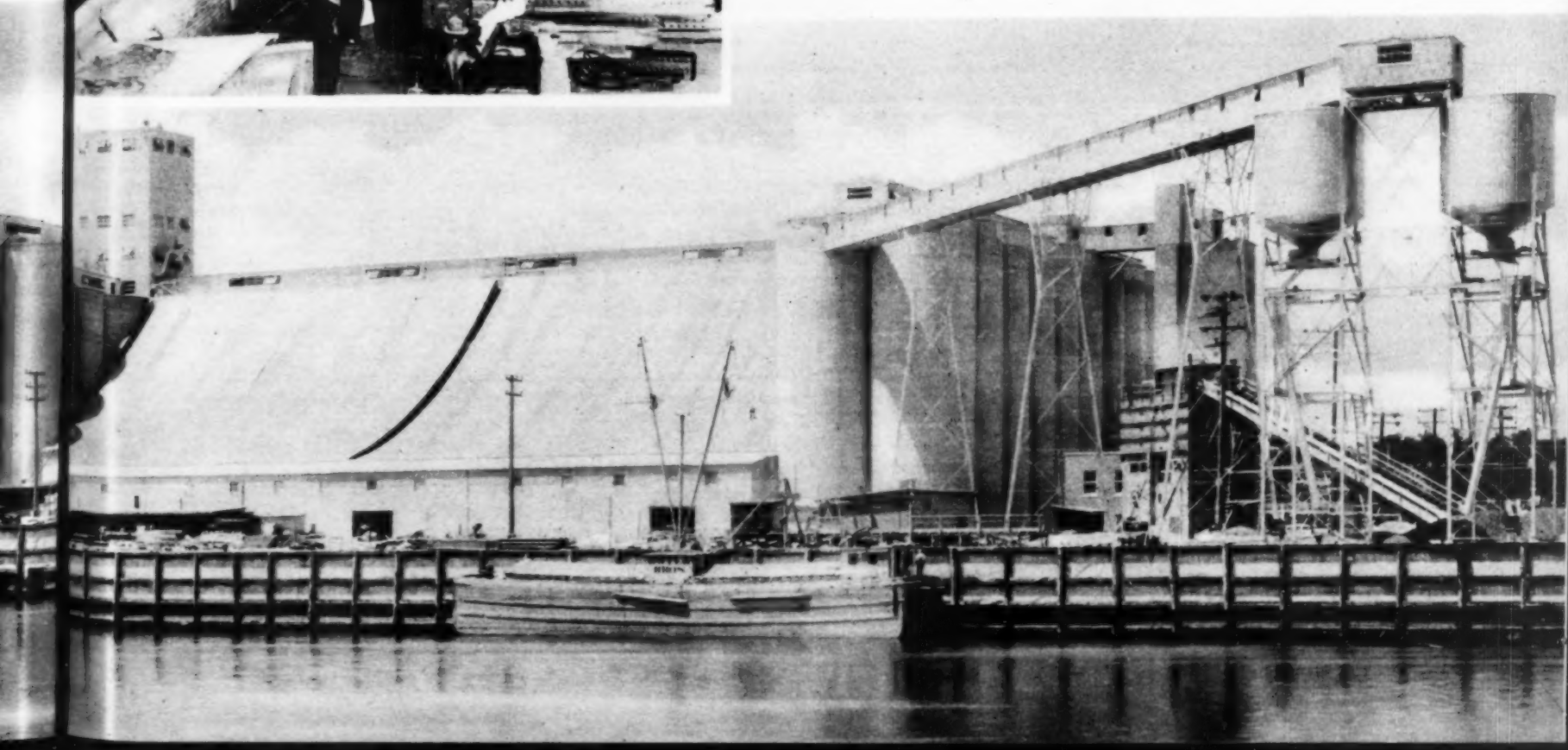
Keystone-Underwood photo

THREE-MILE ELEVATED HIGHWAY crosses New Jersey meadows and Hackensack and Passaic Rivers between Jersey City and Newark. Five-lane roadway, 50-ft. wide, reinforced with welded steel mats, is paved with concrete, as described in detail elsewhere in this issue.



Acme photo

BIGGEST GIRDER *(left)* ever erected as a single unit in New York City, weighing 152 tons, is placed in Post Office Annex. Length, 115 ft. 10 in.; depth, 9 ft. 2 in. Steel member erected by McClintic-Marshall Co., forms part of structure being built by James Stewart & Co., Inc., general contractor, for whom A. L. Felio is superintendent in charge.



TRUCK-MIXERS *and* MACHINE SPREADERS

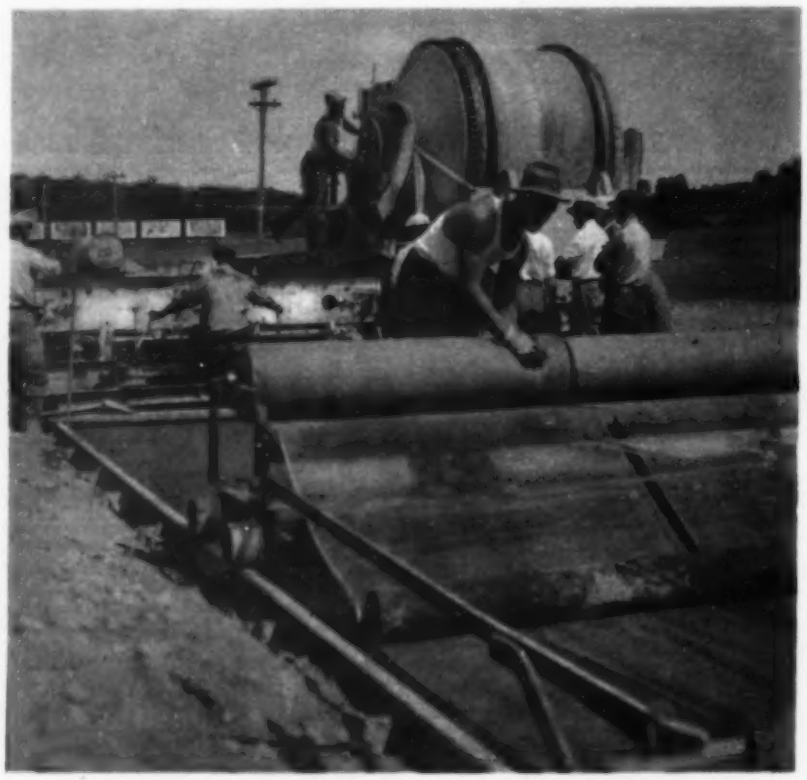
Speed Up Production of Sheet Concrete Pavement by B. Perini & Sons

CONCRETE paving progress at rates averaging 2,700 lin. ft. and reaching a maximum of more than a mile a day of 10-ft. wide, two-course slab, 9 in. thick, involving the placing of more than 1,500 cu. yd. in 11¼ hr., was attained this season on a section of the Boston-Worcester turnpike, in Massachusetts, by B. Perini & Sons, Inc., contractors, of Framingham, Mass. Instead of the ordinary 1-yd. paving mixer on the subgrade, the contractor operated a fleet of truck-mixers which discharged 5-yd. batches of concrete into a new type of self-propelled spreading machine riding on the forms.

The contract, extending eastward from Framingham 5.7 mi. to the Natick-Wellesley line, adjoins the 5-mi. length of the Boston-Worcester turnpike west of Framingham which the Perini organization completed in 1931 and which was described in detail in the January, 1932, number of *Construction Methods*. While the truck-mixer method of handling concrete was used also on the 1931 work, this year's operations developed a number of changes and improvements in both method and equipment that contributed to the remarkably high production records established.

The 1932 contract called for the placing of about 51,000 cu. yd. of concrete in six 10-ft. wide lanes, forming two 30-ft. paved widths, one on each side of a 10-ft. turf-surfaced strip extending along the center of the 70-ft. wide super-highway to separate east-bound and west-bound traffic. The total amount of the contract, which included a bridge to eliminate a grade crossing, in addition to the paving proper, is approximately $1,000,000.

Sheet Concrete Type—The specifications provided for alternate types of paving, one a standard 8-in. thick, one-course reinforced slab and the other a lightly reinforced 9-in. "sheet concrete" slab, built in two courses with a strip of coarse-mesh jute fabric interposed between them to form a cleavage plane between a lean-mix 7-in. base course and a richer-mix 2-in. top or wearing surface. Perini's bid price for the 9-in. "sheet-concrete" type of paving was about $10,000 lower than his price for the standard 8-in. reinforced slab, and the contract was awarded for sheet concrete.



JUTE FABRIC, laid between top and bottom courses, forms cleavage plane in sheet concrete pavement. Truck-mixer and mechanical spreader in background.

With this type of construction, developed by the Sheet Concrete Pavement Corporation of America, the 2-in. top course, above the cleavage plane formed by the jute fabric, may be removed and replaced, when necessary, for cuts, repairs or resurfacing. The 7-in. base course is a fairly lean and dry mix of 1:2½:5 proportions, using stone from 2½ to ¼ in. in size. The top course is a richer mix, 1:1½:2 with finer aggregate, ranging in size from ⅝ to ¼ in. The method is designed to produce a superior wearing surface, eliminate surface scaling and provide a concrete pavement of monolithic strength with a removable top surface.

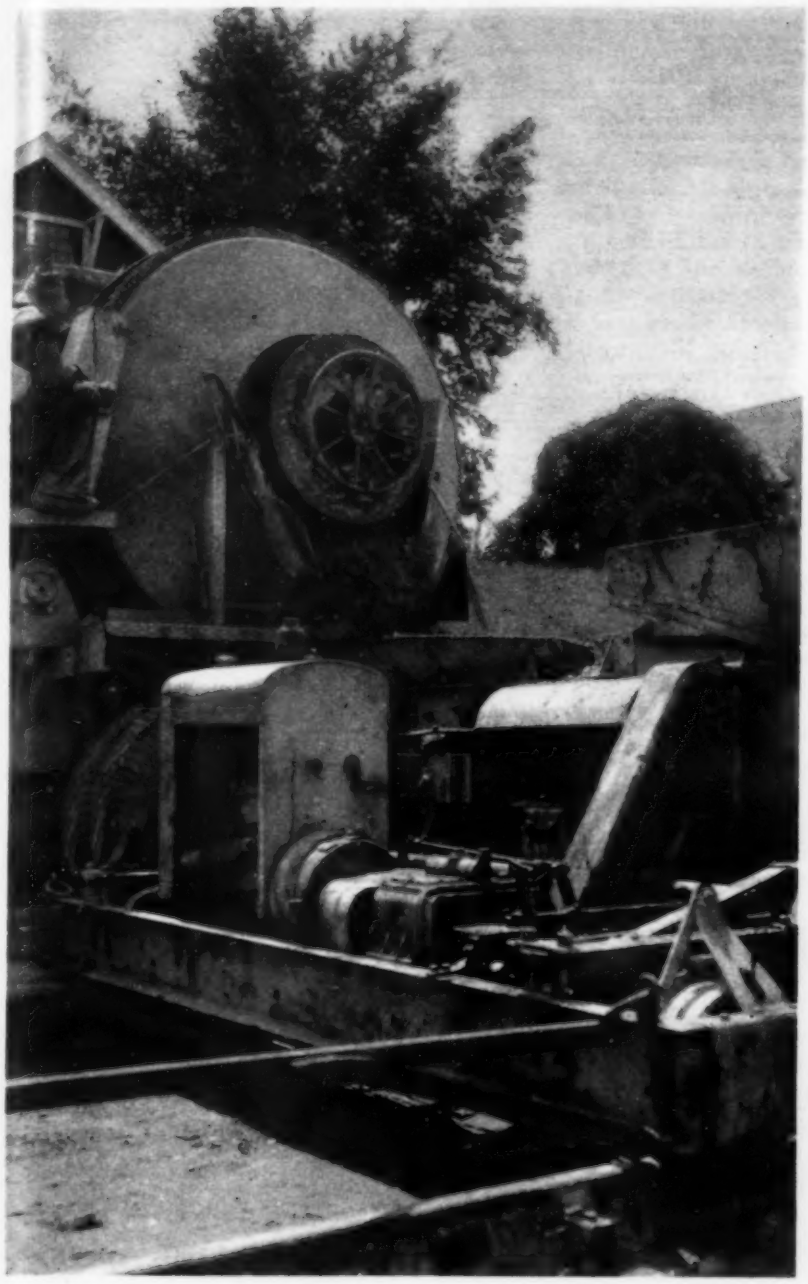
J. M. KEENE, resident engineer, supervising construction for Massachusetts Department of Public Works.

Plant Setup—Successful experience with the truck-mixer method on the 1931 paving contract induced Louis R. Perini, president of the contracting organization that bears his name, to apply the same general operating plan, with improvements, on the 1932 contract. In several essential features the plant setup differs from that of 1931. The major changes and improvements include: (1) Larger truck-mixers, with capacities of 5 cu. yd. instead of 3½ cu. yd. (2) Discharge of concrete from the side, instead of from the end, of the truck. (3) Use of bulk cement delivered by rail in special bottom-dump containers. (4) Distribution of concrete on the subgrade by a new type of mechanical spreader. (5) Curing of the concrete slabs by covering with heavy paper.

LOUIS R. PERINI *(left)*, president of contracting organization, confers with his superintendent, ALFRED LATTANZI.

Along the line of the highway to be paved sand and gravel aggregate are obtained from a pit located approximately midway between the ends of the 5.7-mi. contract section. At this pit a central batching plant was set up to serve a fleet of ten 5-yd. truck-mixers. Sand and gravel are excavated by power shovel, loaded into motor trucks and delivered to a screening and washing plant adjacent to the pit. Oversize material is reduced by a crusher at the foot of a long, inclined belt conveyor, which elevates the aggregates to points of discharge through screens for washing and segregation into the proper sizes. From the screening and washing plant the aggregates descend through chutes into two groups of stock piles alongside two elevated bins serving 5-yd. batching hoppers, one a Blaw-Knox and the other an Erie. A Lorain crawler crane with 1¼-yd. clamshell bucket loads the sand and gravel from the stock piles into either of the two batching bins. The reason for the duplicate batching installation is to allow time for the sand and gravel to dry out, after leaving the washing and screening plant, by working the two stock piles on alternate days.

Bulk Cement—At the batching plant cement from the mill of the Knickerbocker Cement Co., at Hudson, N. Y., is delivered in bulk in L.C.L. closed metal containers, each holding about 25 bbl., designed for railway shipment in groups of 12 units, with a total capacity of about 300 bbl., per car, as illustrated in one of the photographs. After the railway cars are spotted on a siding



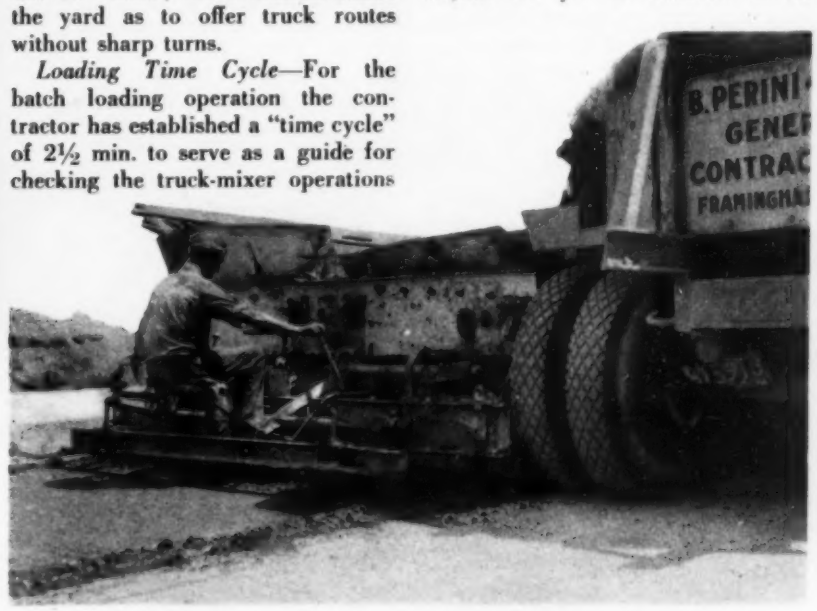
alongside a Butler elevated cement bin, a P.&H. crane, rigged with a special grapple frame, picks up the L.C.L. containers, one by one, and swings them over a pit, below ground level, into which the bulk cement is discharged from the containers through bottom-dump gates, controlled by lines from the crane which function in much the same way as those that open and close a clamshell bucket. From the pit the cement is elevated to the bin by a Fuller-Kinyon pump, weighed accurately for each batch and discharged by gravity into the drum of a truck-mixer below. The cement-pumping capacity is 175 bbl. per hour. There is no cement storage shed on the job; the watertight steel containers on the railway cars serve that purpose. The quantities of cement per 5-yd. batch are 2,200 lb. for the base course and 3,600 lb. for the top course concrete.

To reduce loading time to a minimum the batching yard layout is designed to provide through passage of the truck-mixers under the aggregate and cement bins, with no backing or other time-consuming maneuvering by the trucks. The three elevated bins (two for aggregate and one for cement) are so located within the yard as to offer truck routes without sharp turns.

Loading Time Cycle—For the batch loading operation the contractor has established a "time cycle" of 2½ min. to serve as a guide for checking the truck-mixer operations within the yard, and eliminating unnecessary delays. Beginning with the arrival of a truck-mixer to receive a concrete batch, these yard operations, analyzed in detail and timed by stop-watch, consist of: (1) Stopping rotation of truck-mixer drum; (2) opening drum door; (3) closing wash-water valves; (4) shutting down mixer drum engine; (5) spotting truck-mixer under aggregate bin; (6) charging drum with sand, stone and water; (7) admitting wash water to tank; (8) traveling to cement bin; (9) charging with cement; (10) closing drum door; (11) starting drum-rotating engine; (12) pulling out of yard.

This minute study of the various yard-loading operations disclosed the fact that the time cycle could be shortened by increasing the size of the 4-in. pipe line delivering water to the mixers, as the aggregate charging operation, requiring only 20 sec., was completed before the necessary amount of water could be admitted to the drum.

Truck-Mixer Fleet—When the contract was let, progress schedules were fixed and equipment requirements determined on the basis of producing and laying a total of 51,000 cu. yd. of concrete in 51



MECHANICAL SPREADER receives concrete from side discharge opening of truck-mixer and distributes it uniformly between forms.

CONCRETE SPREADER rides on forms and edge of completed slab. Rear view shows strikeoff plate which levels off surface of mix spread by spiral conveyor at front end. Unit is powered by 20-hp. gasoline engine.

TRUCK-MIXERS, with drums holding 5 cu. yd. of concrete, discharge from side into receiving hopper of mechanical spreader equipped with belt and spiral conveyor to spread mix between forms.

workings days, equivalent to 1,000 cu. yd., or about 3,500 lin. ft., of 10-ft. wide slab, 9 in. thick, per day. Between the batching plant and the extreme end of the job the maximum round-trip haul for the truck-mixers is 6.8 mi., of which 6 mi. is along the right-of-way (on concrete previously laid) and the remaining 0.8 mi. in and out from the plant.

On the foregoing assumptions regarding daily production of concrete, the contractor provided a fleet of 10 Jaeger truck-mixers, each of 5-cu. yd. capacity. For paving purposes, an outstanding improvement in these machines over those employed last year is in their design for side discharge rather than end discharge. Drum capacity has also been increased from 3½ to 5 cu. yd. The mixer units, rotated by individual 45-hp. gasoline engines, are mounted on Mack trucks with dual drive on a pair of rear axles. Weighing, loaded, approximately 20 tons and operated at speeds of 27 mi. per hour, each truck-mixer rides on ten Goodyear pneumatic tires, eight 42x9's for the dual rear wheels and two 40x8's for the front wheels.

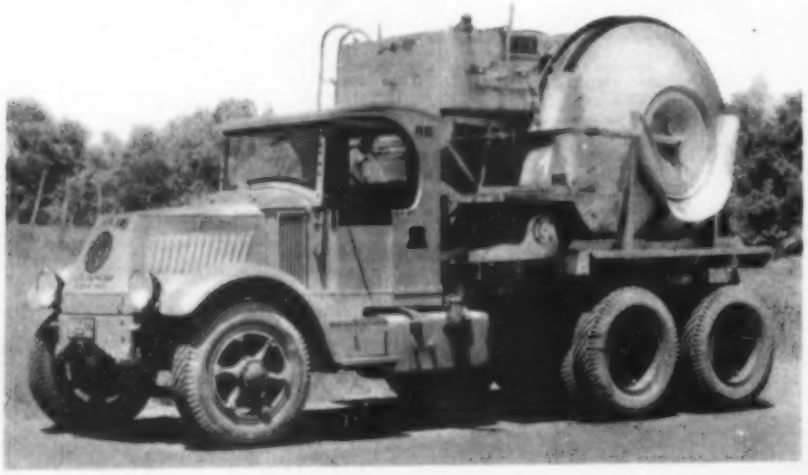
A reversible feature of the mixer drum design makes it possible to shift the discharge opening and the water entry from one side to the other. It is also possible to reverse the direction of rotation of the mixer, in which case three vane extensions are transferred from one side of the drum to the other. The rate of discharge is controlled by a hand-wheel and at full opening a 5-yd. batch of concrete can be discharged in 2-min.

Specifications of the Massachusetts Department of Public Works applying to truck-mixed concrete require a minimum mixing period of 5 min. and forbid the retention of a mixed batch in the drum for a time longer than 1 hr. On the Perini contract the mixing time, while the trucks are in transit to the job from the batching plant, averages about 9 min.

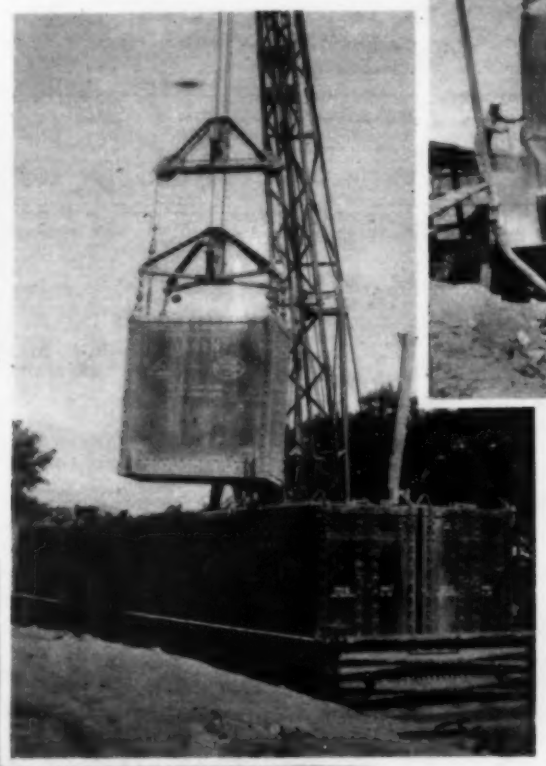
Each truck-mixer is equipped with a 240-gal. water tank divided into three compartments, one of 200 gal. and two each of 20 gal. At the batching plant the proper amount of water for each mix is introduced directly into the drum. Just as soon as the drum has discharged its batch on the subgrade, a charge of 20 gal. of water from the tank compartment is introduced and retained in the empty drum as it rotates during its return trip to the yard. This water prevents concrete from hardening in the drum and serves also as part of the mixing water for the next batch. After every third trip the mixing drum is given a complete wash with water from the 200-gal. tank compartment on the truck.

It will be recalled that two different concrete mixes are required, respectively, for the 7-in. base course and the 2-in. top course of the pavement. To avoid error in delivery a red flag is hung on each truck mixer carrying the rich top-course mixture. When paving is progressing according to schedule, every fourth truck carries top-course concrete, and the others, the base-course mix.

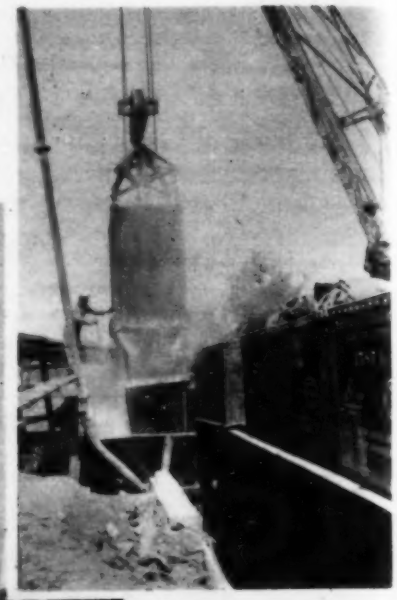
Concrete Spreading Machine—On arrival at the subgrade a truck-mixer, which has been driven along one of the 10-ft. lanes previously



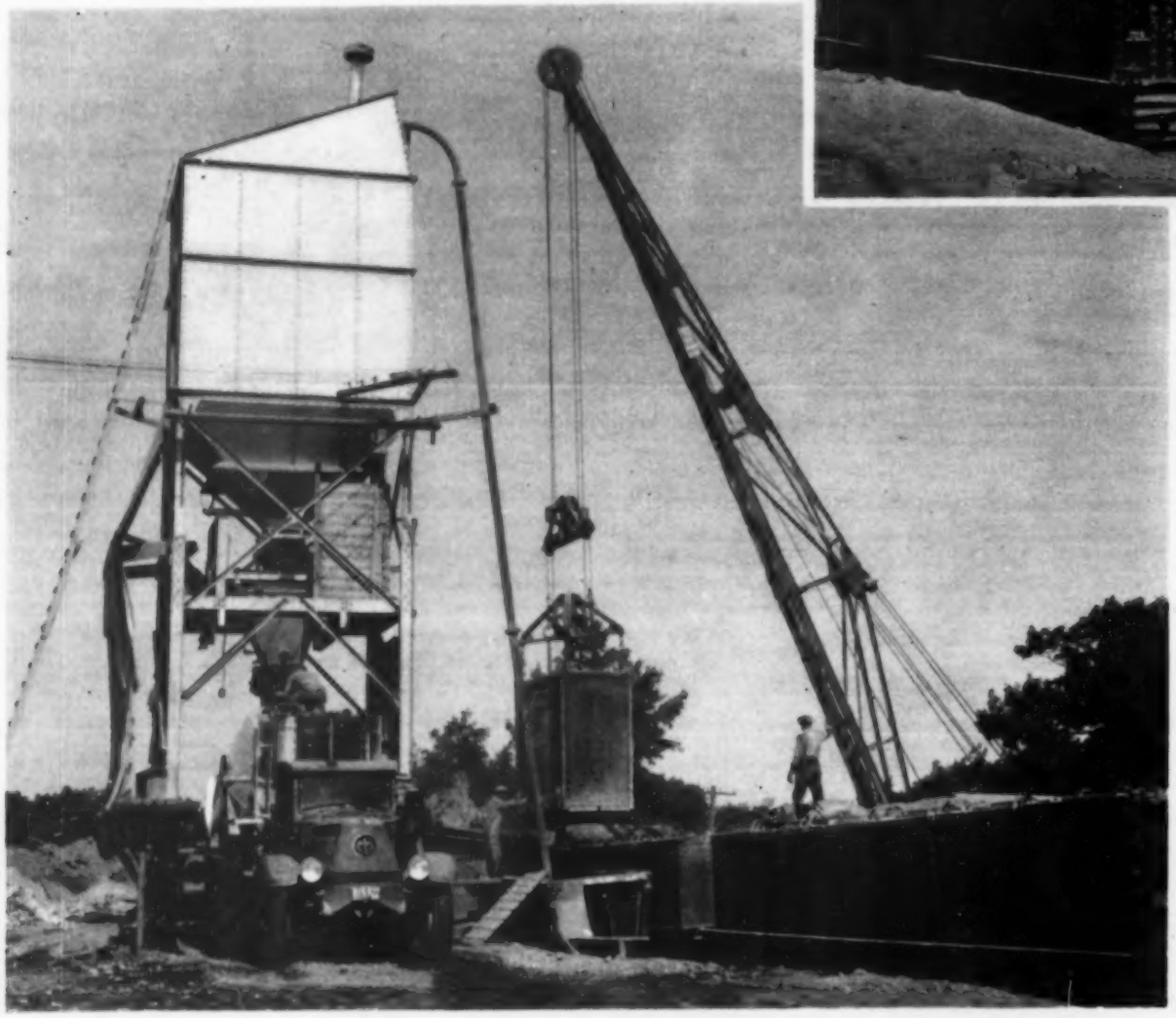
TEN PNEUMATIC TIRES are part of the equipment of each unit in the fleet of ten 5-yd. truck-mixers. Weight of loaded truck is 20 tons.



CEMENT CONTAINER *(left)* is bottom-dump steel box holding 25 bbl. Mechanism for opening and closing is like that on clam-shell bucket.



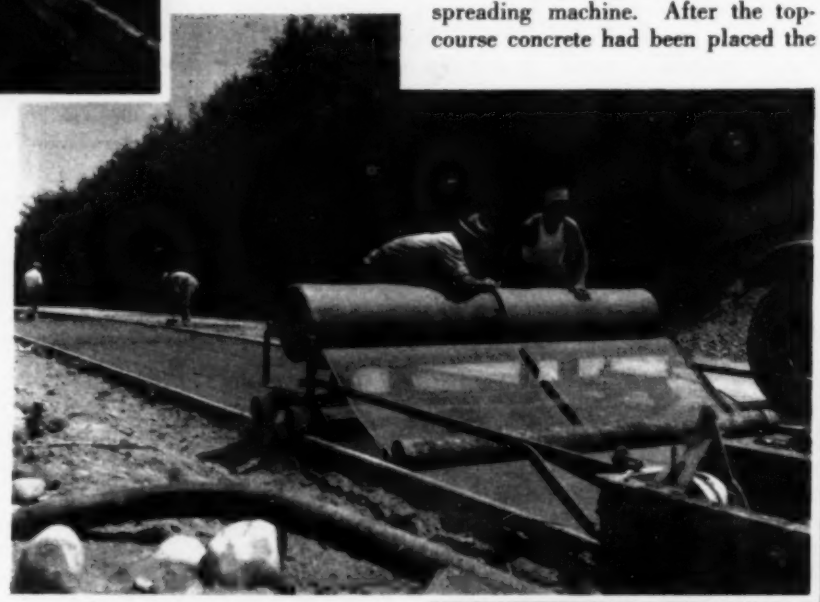
AFTER DUMPING into pit bulk cement is pumped through pipe *(at left)* to overhead weighing bin.



BULK CEMENT PLANT consists of overhead bin and weighing devices. Cement is delivered by railway in watertight steel containers which are unloaded by crawler crane.

SUBMERGED JOINT *(left)* **allows concrete spreading machine clearance for passing. Premolded joint material is later raised to within 1 in. of finished pavement surface.**

CARRIAGE *(below)*, **riding on forms, carries rolls of jute fabric to form cleavage plane in two-course concrete slab. Heavy roller, at rear end, presses fabric into wet concrete.**



concreted, discharges, from the side, its 5-yd. batch of base-course concrete into the hopper of a mechanical spreading machine, a new development of the Jaeger Machine Co. This unit, powered by a 20-hp. gasoline engine, is mounted on wheels that ride on the forms or the edges of finished paving slabs. Below the hopper into which the truck-mixed concrete is discharged is a short endless belt conveyor, 36-in. wide, which carries the concrete half way across the 10-ft. width of the lane being concreted. From the end of the belt the concrete drops upon a deflector plate which splits it into two streams which are then moved out toward each side of the pavement by spiral screw conveyors. Behind the spiral conveyors is a strikeoff plate which levels off the concrete of the base course to the proper grade. Finally, a tamping bar on the spreading machine consolidates the concrete in place and depresses any stone aggregate that may protrude above the surface of the base course. Both the screw conveyors, for the lateral distribution of the concrete, and the strikeoft and tamper are adjustable, vertically, to bring the top of the base course concrete to the desired elevation below the tops of the forms prior to the spreading of the jute fabric layer and the placing of the 2-in. top course.

The spreading machine has two forward traveling speeds, one of from 9 to 15 ft. per minute and the other of from 30 to 40 ft. per minute. The speed in reverse is 100 ft. per minute. The two forward speeds are necessary to accommodate the different rates of progress that obtain in spreading the comparatively thick (7-in.) base course and the thinner (2-in.) top course. Speed ranges are controlled by throttling the engine on the spreader.

The spreading machine is not intended to produce a perfectly smooth, compacted surface, but rather to get the concrete into place quickly and cheaply for subsequent machine finishing and to eliminate the hand labor ordinarily required in the "pit" for spreading batches of concrete as they are dumped on the subgrade by a paving mixer.

The base-course work is duplicated in method and equipment for the 2-in. top course. Behind the base-course spreader follows a second spreading machine which pushes in front of it a carriage carrying rolls of ¼-in. mesh jute fabric which is unwound and smoothed down by a heavy roller, as the machine moves forward, to form the cleavage plane between the base and the top courses of concrete. One of the photographs illustrates clearly how the fabric laying operation is handled. The width of the jute fabric is 4 ft. 10 in. and two rolls are unwound simultaneously to cover the 10 ft. width of the slab.

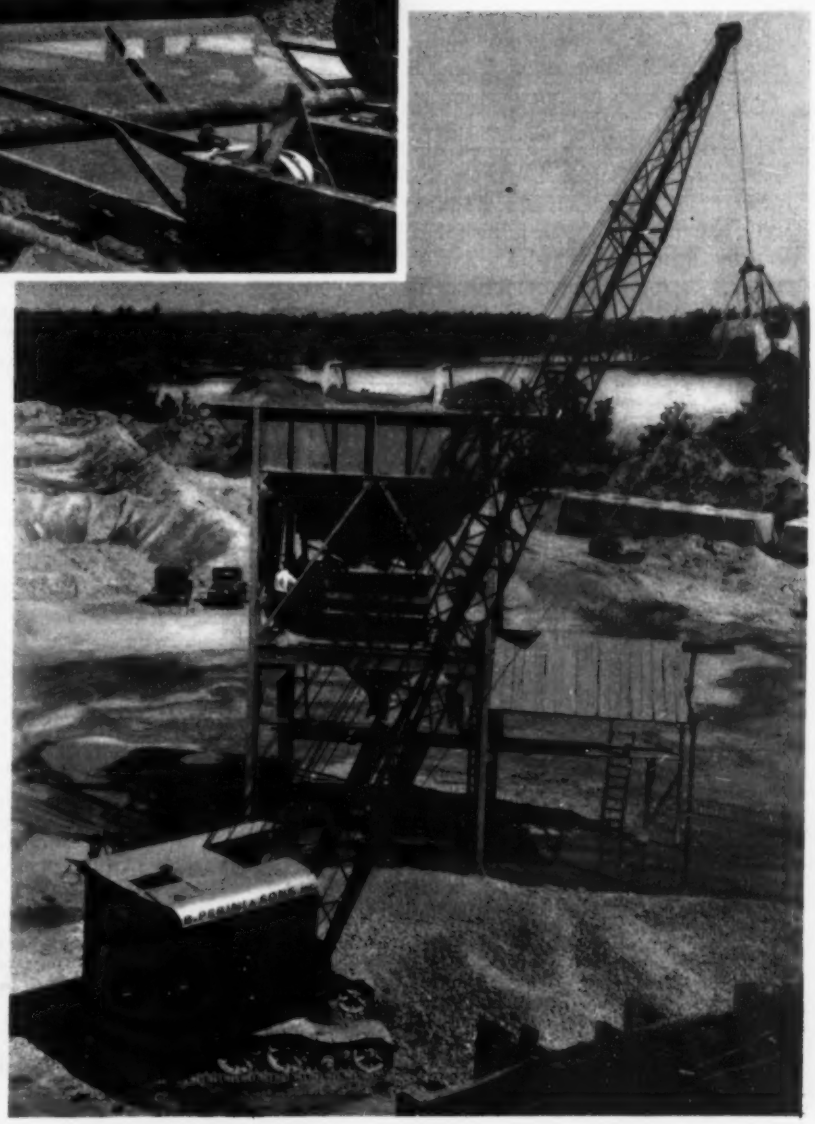
Upon this fabric layer concrete for the 2-in. top course is deposited from truck mixers with side discharge and spread by a machine of the same type as is used on the base course, previously described.

Behind the top-course spreader a standard concrete finishing machine, supplemented by hand belting and transverse brooming, completes the paving operation. Curing during the first 24 hr. is done with moistened burlap and after that by covering the green concrete with heavy kraft paper.

Joints—Transverse joints were placed in the paving at intervals of 57 ft. and filled with a premolded asphalt strip. On account of the two-course construction and the necessity of striking off the base concrete 2 in. below the tops of the forms it was necessary, before concreting, to depress the premolded strip of joint material in a groove excavated 2½ in. deep across the subgrade to provide clearance above it for the passage of the concrete spreading machine. After the top-course concrete had been placed the premolded joint strip was pulled up to within 1 in. of the finished paved surface by hooks applied at each end. The 1-in. depth at the top was later filled with liquid asphalt.

Progress—During the course of this year's contract for the Boston-Worcester turnpike the production and placing of concrete by Perini's truck-mixer and mechanical spreader method have averaged 750 cu. yd., or 2,700 lin. ft. of 10-ft. wide lane, per 10-hour day. With this method of concrete delivery in pre-mixed 5-yd. batches there is no bottleneck limiting output, as is the case with an ordinary 1-yd. paving mixer on the subgrade.

Personnel—The work described is under the direction of the Massachusetts Department of Public Works, of which Arthur W. Dean is chief engineer, F. D. Sabin district engineer and J. M. Keene resident engineer. For B. Perini & Sons, Inc., contractors, of Framingham, Mass., Louis R. Perini is in general charge, assisted by J. L. Doherty, general superintendent, and Alfred Lattanzi, superintendent on the Boston-Worcester turnpike contract.



SAND AND STONE from washing plant are transferred from storage piles to elevated bin of batching plant by crawler crane with 1¼-yd. clamshell bucket.

Recent Trends in
SURFACE TREATMENT

By L. P. STREET
Assistant Engineer
West Virginia Highway Commission

DURING the last half-dozen years surface treatment for roads has greatly broadened in scope. Until recently we regarded surface treatments as a property owner thinks of his house roof when it begins to leak, merely as a means of covering and waterproofing an existing surface. Today we have not only altered our opinion as to the results that can be obtained by such treatments, but have completely changed our ideas as to the ideal surface after it has been treated.

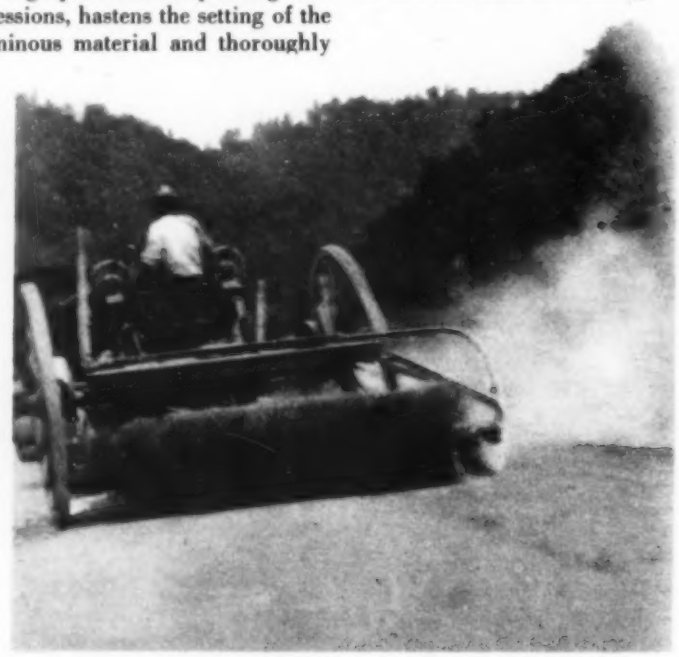
Previously, most highway engineers thought that a bituminous surface would not last unless it were black and smooth, with no visible stone. Today, as we drive over many of the old, fat, slick bituminous surfaces, it would seem that highway engineers had the old paint slogan "Save the surface and you save all" in mind to such an extent that they applied excessive bituminous material to road surfaces, making them dangerously slick for automobile traffic. The increase in high speed traffic and the greater number of serious accidents have made it necessary to devise methods of remedying the over-treated surfaces.

Non-Skid Surface—Highway engineers should always keep in mind that the present roads are mainly used for high speed automobile traffic, and that their work should be carried on with a non-skid surface as one of the main objectives.

In this type of work we should always remember that it is easy to add a little more bituminous material, but very difficult and expensive to remedy the ill effects of an excessive application. A further disadvantage in the use of excessive bituminous material is that it may cause the surface to push and corrugate under traffic.

The advent of the methods used in retread construction has probably had more to do with the changing of ideas in connection with this type of work than any other thing. Many long drags and leveling devices have been developed for use in retread construction, and many of the same ideas and uses for the same kinds of equipment have been transferred to treatment work. All surface treatments should certainly be dragged. The dragging of a treatment smooths the existing surface by taking stone from high places and depositing it in depressions, hastens the setting of the bituminous material and thoroughly mixes materials, thus saving much of the stone that would not otherwise be coated with bituminous material, and, of course, would be kicked off the road by traffic.

In the past, many arguments have arisen concerning the superiority of certain bituminous materials, but it is believed that satisfactory results can be obtained with most materials, provided the engineer is thoroughly familiar with his work and the kind of material that he is using.



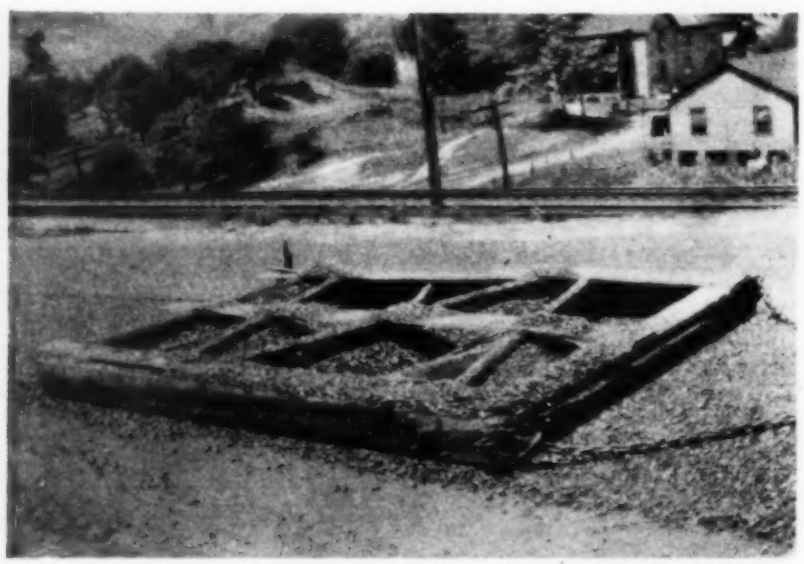
SWEEPING of gravel base by horse-drawn broom is done before prime coat is applied.

There is an endless variety of methods that can be followed to obtain good results, but excellent surfaces have been obtained by proceeding with different materials as described below.

Surface Treatment on New Bases—At a time when the entire country is demanding rigid economy in all public expenditures, it behooves the engineer to search for bargains in construction methods and to adopt every economical road-surfacing material that will adequately carry the traffic. There are few methods of cheap construction that can be compared with the excellent riding surfaces obtained by light surface treatments on gravel, sandstone, chert, shale, or any other thoroughly compacted base. Where the applied price of stone is $2.70 per ton and the applied price of bituminous material 9c. per gallon, satisfactory treatments have been made on surfaces 18 ft. wide for a cost of $1,600 per mile. The steps in connection with a treatment of this kind are as follows:

(1) Clean the surface by sweeping or blowing. The surface can be cleaned better by sweeping first and then blowing. (2) Apply prime coat of light bituminous material, 8 to 13 viscosity at 40 deg. C., at the rate of ¼ to ⅓ gal. per square yard. (3) After first application of prime has had sufficient time to dry and harden, apply a second application of slightly higher viscosity at approximately the same rate per square yard. (4) Cover second application with stone (approximately 10 lb. per square yard). (5) After prime has thoroughly dried, spread stone on the surface at the rate of approximately 30 lb. per square yard. (6) Apply bituminous material, 35 to 50 viscosity at 40 deg. C. at rate of ⅓ gal. per square yard. (7) Drag surface with a long drag that will thoroughly mix and level the material. (8) Make one trip over surface with roller. (9) Apply stone screenings, ranging in size from the mate-

BROOM DRAG hauled by motor truck follows immediately behind distributor, applying quick-setting emulsion.



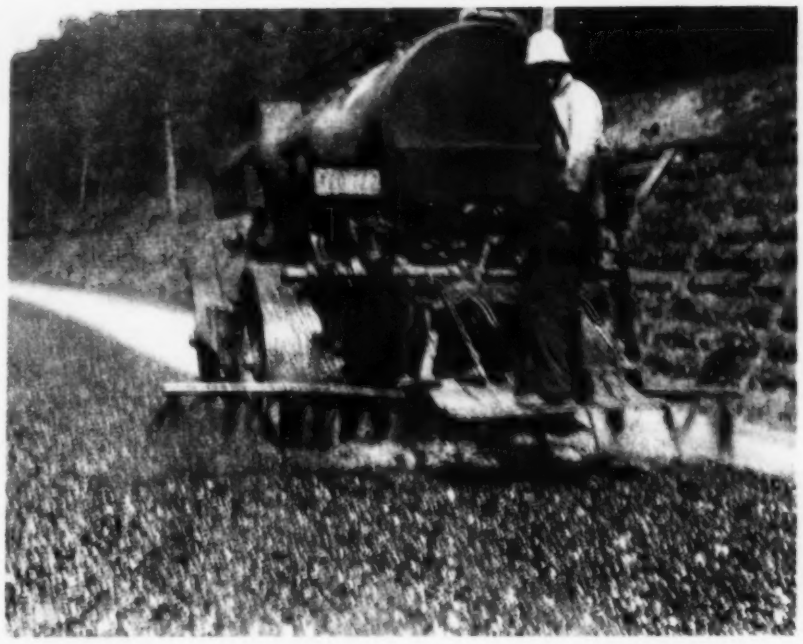
DETAIL of surface treatment drag, showing how bituminous material and stone are mixed and smoothed.

rial passing a ¼-in. opening to the material retained on a No. 10 mesh opening. (10) Broom the surface with a broom drag so constructed that it will work the fine material back and forth on the surface completely filling all of the voids. (11) Thoroughly roll the surface with a roller weighing from 8 to 10 tons. The brooming should be continued the entire time that the surface is being rolled. There is little danger of over rolling, provided a good quality of stone is used.

In this type of construction the importance of obtaining a good prime coat cannot be over-emphasized. This is the first major step and the keystone on which the success of the entire work depends. The prime material should be applied only when the surface is absolutely dry. From the results obtained in this type of work, it has been found that two applications of prime are fully justified. Until recently, light tars were used almost exclusively for priming material, but in the last two years special efforts have been made to produce an asphalt especially for priming and some satisfactory results have been obtained.

Fine stone is not often applied as in step No. 9, above, but a much better surface can be obtained by making this application of stone. The fine stone works into all of the voids, keys the stone very tightly and greatly diminishes the chances of the larger stone being displaced under traffic. In most cases, there will be a sufficient amount of bituminous material to bond the finer stone particles to the larger, making a dense, waterproof surface. Another distinct advantage of the fine stone is that automobiles will pick up very little of the treated stone after the fine material has been applied.

Treatment On Old Bituminous Surfaces—After the surface has been cleaned, the treatment on old bituminous surfaces is carried out substantially as outlined above, beginning with Step No. 5, except that better results can be obtained by applying a very light application of the same grade of bituminous material, approximately ⅛ gal. per square yard, before spreading the stone. This application of bituminous material serves to seal the old surface and kills the effects of dust in the stone.



APPLYING bituminous material from distributor after stone has been spread on surface of highway.

Before surface treatments were dragged, the usual practice was to apply all of the bituminous material before spreading any stone, but the dragging thoroughly mixes the materials, and coats the stone completely with bituminous material. If the bituminous material is applied before the stone, automobiles will pick up more of it, the surface will be much slicker before the stone is added, there will be grave danger of wrecks and there will be nothing to hold the bituminous material in place on the road.

When an asphalt is used, the spreading of the stone before the application of asphalt allows one to use and drag a fairly quick-setting material.

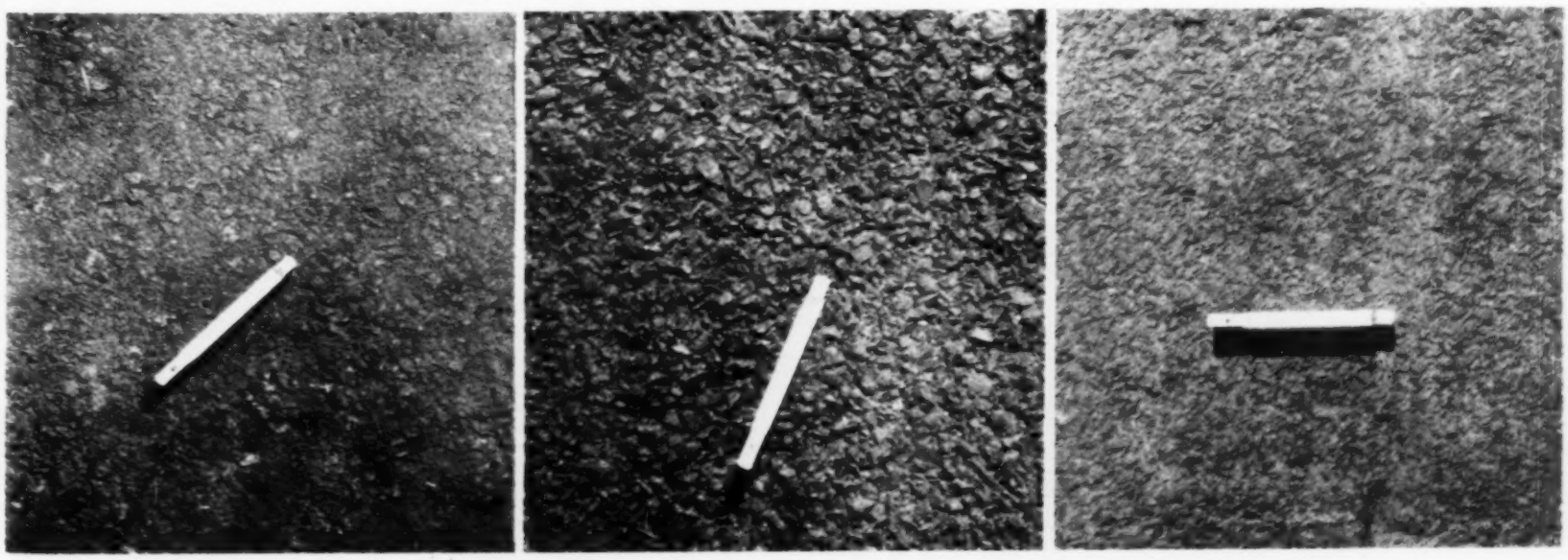
It might be thought that the same results could be obtained by mixing the fine material with the coarse and applying all of the stone in one application, but in actual practice the dragging works the coarse material to the top and the fine to the bottom, thus making an upside down surface or one dense in the bottom and open on top.

The amount of bituminous material to be used per square yard will vary with the aggregate used, but one will not go far wrong in figuring 0.1 gal. for each 10 lb. of stone.

Treatments with Quick-Setting Emulsion—The use of quick-setting emulsions for surface treatments originated recently. Some of the inducements for using this material are that it can be applied on a damp surface, wet stone can be used, and it is very quick-setting, inconveniencing traffic for only a short time. Due to the quick-setting properties of the penetration emulsion, it must be dragged immediately after it is applied. When first applied, emulsion has a light brown color and flows almost as readily as water. The quick-setting emulsion can be dragged for a few minutes after it has been applied, without breaking it loose from the stone. After the emulsion has been down for a short time and begins to turn black, it should not be dragged or rolled until it has been completely set to the stone. During the period that this material should not be worked, the emulsion can be easily pulled from stone, but at the end of the peeling period rolling can be continued without injury to the material. Best results can be obtained by leveling the stone as much as possible before applying the emulsion. After the application has been made, it is necessary to make only one trip over the surface with a broom drag following immediately behind the distributor.

It has been found that satisfactory results can be obtained by following the procedure outlined below:

(1) Clean surface. (2) Apply 0.1 gal. of emulsion per square yard. (3) Spread approximately 25 lb. ½ to ¾-in. stone on surface; spread the stone as evenly as possible. (4) Apply emulsion at the rate of ¼ gal. per square yard. (5) Follow immediately after bituminous distributor with a broom drag; one trip over the surface should be sufficient after the emulsion has been applied. (5) Allow emulsion to set completely to the stone. With a quick-setting emulsion, the setting period takes from 30 to 50 min. When it is safe to roll the treatment, the emulsion will not peel loose from the stone. (6) Roll surface with 8- to 10-ton roller. (7) Spread 8 to 10 lb. of 1.4-in. to No. 10 mesh stone on surface. Thoroughly broom and drag the surface after the final application of stone.



TEXTURES of road surfaces after treatment. At left, result of treatment with quick-setting emulsion. In center, open, porous surface to which fine stone was not applied. At right, surface into which fine stone was broomed to produce dense, tightly sealed top.

Getting Down to DETAILS

Close-up Shots of
Job Methods and Equipment

HOMEMADE STEEL DRAG, ready for moving to new location by Westmoreland County forces of Pennsylvania State Highway Department, is jacked up on bearing plate by pump-handle operation of double beam. Links of chains on opposite sides of fulcrum alternately lock in slots of lifting block.

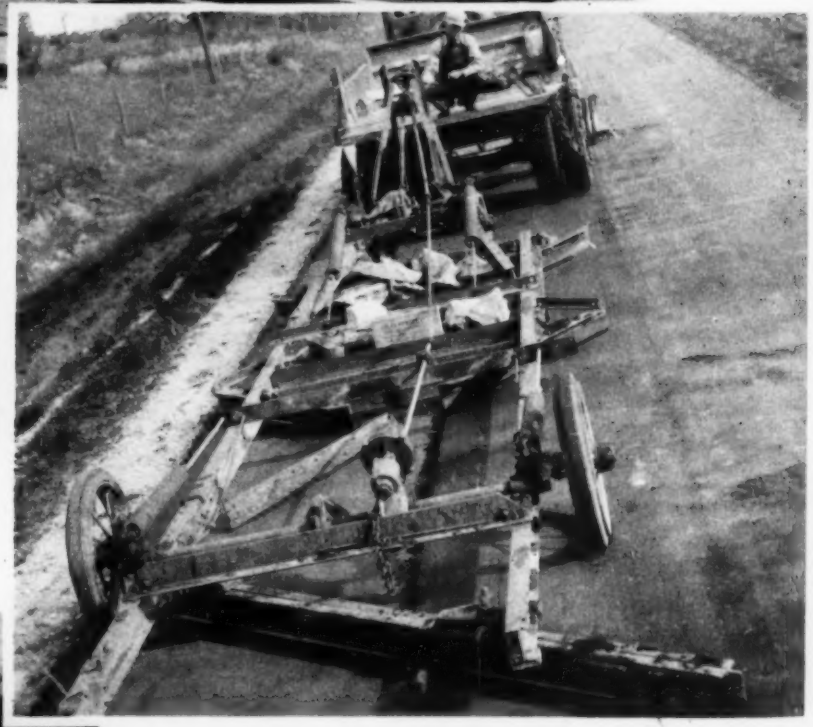
CENTER-LINE MARKER has long wheel-base, 30 ft., and narrow tread, 30 in., so that traffic may pass the machine on either side while it is in operation, thus minimizing crossing of freshly painted lines.— ***Photo from* A. H. HINKLE, *superintendent of maintenance, Indiana Highway Commission.***

TAMPER FOR WIDENING STRIP. Crawler-mounted device, powered by gasoline engine, has movable arm carrying tamper in form of vertical shaft shod with wood block which uniformly compacts bituminous strip along pavement edges and irons out irregularities left by rolling.— ***Photo from* H. P. CHAPMAN, *assistant director, Ohio Department of Highways.***

PROFILOMETER, developed by Ohio Department of Highways, marks irregularities in pavement surface. As it passes over bumps or depressions, indicating wheel on straightedge releases spray of white paint. Truck battery supplies current for electric coil controlling spray, which is ejected by compressed air from tank on truck. Equipment may be knocked down for transport in truck.— ***Photo from* H. P. CHAPMAN, *assistant director, Ohio Department of Highways.***

BELT CONVEYOR DISTRIBUTOR places transit-mix concrete on new street under construction by Fay Improvement Co. to intersect Sunset Boulevard near San Francisco. Device is mounted on rubber-tired wheels and may be swung across subgrade.

DRAGLINE BUCKET ADAPTED to use as tractor-drawn hydraulically-operated scraper for road grading. Open-bottom Sauerman unit has capacity of 1½ cu. yd. Curved "crescent" design gives blade plowshare cutting action.



LONG-BASE DRAG is improvised by welding 8-ft. extensions to frame of standard Adams maintainer. In planing bituminous surfaces long drag rides smooth and is free from "throws."—*Photo from* A. H. HINKLE, *superintendent of maintenance, Indiana Highway Commission.*

CANTILEVERED SIDEWALK *(left)*, is added to through-truss state highway bridge in Ohio for use of school children and other pedestrians. Supporting beams pass through lower chord of truss and are fastened to bridge stringers

SODDING steep back slopes in Michigan is simplified by equipping flat-bottom 1-ton trucks with manual hoist and false-bottom wood racks of 2x8x16's, joined by four cross-cleats. In unloading, truck platform is tilted by hoist, allowing racks, carrying sods, to slide off on to ground as truck backs away. Method prevents damage suffered by sods in ordinary dumping. Four-man crew placed 600 sq. yd. of sod per day at cost of 9.3c. per square yard.—*Photo from* G. C. DILLMAN, *state highway commissioner, Michigan.*

Pennsylvania Applies SPREAD-WORK PRINCIPLE *to Construction of Low-Cost Rural Roads*

PENNSYLVANIA'S program of rapid construction for the 20,000 mi. of township roads which it added to the state highway system on Aug. 15, 1931, has resulted in the building of almost 4,000 mi. of these roads in the first 16 months since the plan went into operation. By reducing to a minimum the preliminary engineering work and supervision of individual projects and by employing local materials for construction almost exclusively, the state department of highways has built this mileage of rural roads without exceeding the cost restriction of $6,000 per mile. Various types of construction have been developed to meet the needs of local traffic at this low cost.

Rural System—A total of 4,600 local roads, selected by the state highway department, were defined by terminal points in the legislative bill of 1931, adding 20,000 mi. to the state system. About one-fourth of the total mileage taken over had been improved to some degree. The entire rural system was put under efficient maintenance at once, and the improved roads were given first attention to preserve them by patching, edging, resurfacing and installing drainage where required.

In addition to these activities, the highway department placed 2,500 mi. under construction in 1931 and increased this amount by 3,000 mi. in 1932. Of the 1932 mileage, two authorizations of 1,000 mi. each released early in the year have been largely completed, and the third program of 1,000 mi. was expected (on Dec. 6) to be authorized soon. Because of the practical necessity of placing the projects under construction as quickly as possible to relieve unemployment, without the delays of drawing plans and letting contracts, state forces have performed nearly all the work. By distributing the authorized construction throughout 66 counties of the state and by an effective system of spreading work, the state highway department has maintained an average or more than 30,000 men employed each month of 1932.

Road Design—Roads are graded a minimum of 22 ft. wide and surfaced for a width of 14 ft., with 4-ft. berms on either side. A base course 6 to 10 in. deep ordinarily is built of local materials such as native stone, gravel, or slag, and a bituminous treatment is applied to the top to seal the surface and cement the metal of the wearing mat. As the roads are held to a maximum cost of $6,000 a mile and are built after only the simplest engineering investigation, great dependence for sound construction falls upon the supervising engineers, superintendents and foremen, whose experience and judgment largely determine the design and working methods on any project.

POWER SHOVEL excavates close to final cross-section in widening and reducing grade for rural road. Low rentals of $3.70 per hour for ¾-yd. shovel and $5.00 per hour for 1¼-yd. machine, including operator, make possible fairly extensive grading within cost limit in Westmoreland County.

HOT SOUP, COFFEE AND SANDWICHES, delivered to job from camp kitchen by truck, provide nourishing noon meal for workmen from county labor camp. Soup and coffee containers are from rolling kitchens of National Guard.

FIELD STONE for napped-stone base is delivered to subgrade by local teams hired for 65c. per hour, including driver. Each wagon hauls about 1 ton of stone.

SLEDGING STONE to 5-in. maximum dimension for construction of 6-in. compacted napped-stone base. This type of pavement furnishes employment for large number of men.

RECLAMATION PROJECT on old pike which offers good limestone base for new surface. After scarifying, shaping and rolling base, county force applies prime coat and builds asphalt-bound limestone surface, mixed in place.

New roads usually adhere fairly closely to old locations, except where a new alignment is manifestly necessary or where a desirable change can be made without too great expense for grading. When a relocation has been decided upon, the state first asks the property owners for a release and, failing success in this effort, requests the county to condemn land for the new right-of-way. One or the other method nearly always obtains the desired result, but if both fail the road remains on the old location.

Thorough drainage of the new roads is assured by adequate side ditches and by cross-drains of corrugated metal pipe at frequent intervals. Cost of the corrugated pipe drains ranges from $500 to $700 a mile. Surface treatment costs $800 to $1,000 a mile, and the expenditure for the base course can be estimated when the price of local material is known. Deducting the cost of these items from the maximum allowable expenditure of $6,000 a mile, the district engineer and county superintendent have the remainder available for grading.

On many projects grading involves power-shovel operation. Although work consists mainly of side-casting

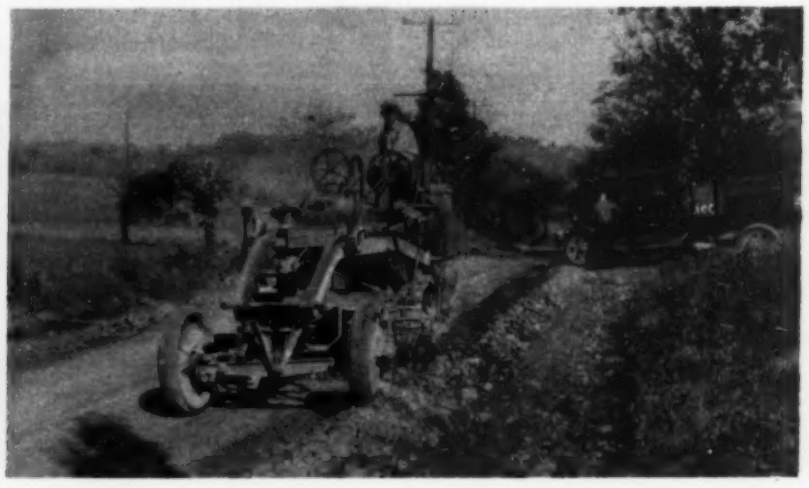
BANK-RUN GRAVEL for 7-in. compacted base of Allegheny County rural road contains good proportion of sand and loam. Spreader boxes distribute gravel on subgrade to proper loose depth for rolling.

to widen the road, it also involves some truck hauling in building new locations, reducing steep grades (usually of more than 12 per cent), removing sharp changes of grade and easing curves. The shovels cut as close as possible to final grade, and power graders complete the trimming and shaping of subgrade and shoulders. On projects requiring no grading heavier than plain sidehill widening, power graders alone are used.

Base Course—Because much of the rural road construction is progressive in character, being carried forward in stages, it is difficult in many cases to differentiate between base and surface courses. On some projects it is necessary to maintain the base course under traffic until stability is obtained, and often these projects are given a light bituminous treatment to preserve the road during consolidation.

Base courses are constructed of a variety of local materials. The most important of these are native stone napped in place, slag, and run-of-bank gravel. Other materials employed to a more limited extent are sand-bearing shale, "red dog" (the residue of ash left after incineration of culm banks at bituminous coal mines), flint, river gravel, and crushed rock. De-

MOTOR GRADER works in conjunction with 10-ton three-wheel roller shaping 7-in. gravel base. Base is surfaced with top course consisting of 60-lb. of limestone chips and ¾-gal. of bituminous binder, put on in two applications.



TO THROW UP EARTH SHOULDERS and complete shaping of subgrade, preparatory to base construction, power graders commonly are used. Roads ordinarily are graded 22 ft. wide and surfaced for width of 14 ft.

pending upon the value of the old road as a foundation and the design of the new road, the base is made 4 to 6 in. thick. A 6-in. compacted depth is commonly specified, except in the case of bank-run gravel, for which a greater thickness is required.

Napped Stone Base — Where a tough, durable native stone is available, the highway department prefers to use it as a base for rural roads. The stone, broken in place with sledges, makes a sound foundation for the road and affords wide employment for local labor without increasing the cost beyond that of other materials. Stone which crushes to sand under the roller cannot be used for this purpose.

Stone is dumped on the rolled subgrade, napped to a 5-in. maximum dimension and shaped to proper crown before being compacted to 6-in. depth by a 10-ton three-wheel roller. Voids in the stone are filled with smaller stone fragments, granulated slag, cinders, or limestone screenings to obtain proper stability.

Other Base Course Materials — Gravel and run-of-crusher slag or rock for the base course of rural roads must all pass a 4-in. circular opening, and not more than 15 per cent is permitted to pass a 1¼-in. circular opening. Filler of the types specified for napped stone roads is used on bases of crushed slag or rock. Bank-run gravel usually contains sufficient clay and loam to fill the voids.

A second size of crushed slag, up to 2½-in. maximum dimension, containing about 30 per cent dust, is utilized in some districts for base construction. This slag requires no additional filler.

Grading of flint and "red dog" is not necessary, as these materials are naturally of smaller sizes. Extensive utilization of "red dog" as a base material was made in 1931 in the southwestern part of the state, where burned culm banks are common. Sections built of this material have passed satisfactorily through their first 12 months under traffic, but the district engineers have decreased the use of the material because of some doubt as to the permanence of a base of this type.

CRUSHED SLAG (*below*) is shaped to proper cross-section loose, before compaction by roller.

10-TON THREE-WHEEL ROLLER (*below*) compacts slag base to 6-in. depth by initial rolling.

STEEL SPREADER BOX (*above*), resting on subgrade and attached to dump truck, distributes run-of-crusher water-cooled slag of 1¼ to 4-in. grading for 6-in. compacted base.

SLAG SCREENINGS to amount of 80 lb. per square yard to fill voids in slag base are applied in three applications by tail-gate dumping from truck, followed by brooming and rolling.

tensively in the construction of the rural system, is one such type.

To construct an oil-bound macadam surface the field force spreads a specified grading of ¾-in. commercial stone to obtain a compressed depth of 2 in. After thorough rolling, a pressure distributor applies ¾ to 1 gal. of asphalt cut-back or high-viscosity tar in two applications. Following the first application of ½ to ¾ gal., sufficient to give thorough penetration without excess, the surface is rolled to uniform cross-section with a 10-ton roller and is allowed to dry for 24 to 36 hr. Immediately after the second application of bituminous material, applied at the rate of ¼ gal. per square yard, ½-in. commercial-size stone is spread uniformly, 20 lb. per square yard. Finally the surface is rolled until thoroughly compacted.

Another type of one-course pavement is the traffic-bound road constructed of stone, slag or crushed gravel to a compressed depth of 2 to 5 in., depending upon the condition of the subgrade. If gravel is used, it is required to contain at least 40 per cent of crushed fragments. All aggregates for this pavement must pass a 1½-in. circular opening and contain 5 to 25 per cent of finer particles passing a ¼-in. circular opening to assure stability under rolling and traffic. After thorough compaction by rolling, the aggregate is treated with asphalt cut-backs or high-viscosity tars, and the surface then is chipped with ¾-in. commercial stone, slag or crushed gravel containing at least 80 per cent of crushed particles.

On rural roads near urban centers, where heavier traffic is carried, it is necessary to construct higher types, such as surface-treated macadam (the various bases for which already have been described), bituminous pene-

PRESSURE DISTRIBUTOR applies ¼ gal. of low-viscosity tar on 20 lb. of limestone chips in surface treatment of napped-stone base. This final application is followed by dragging and rolling.

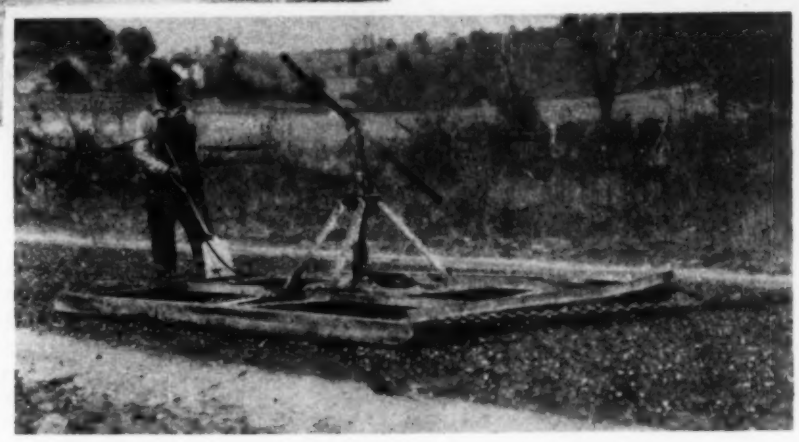
tration macadam, or bituminous concrete. Where bituminous concrete is considered necessary, the highway department finds it economical to use mixtures of the cold-laid type. In addition to these pavements, the department has constructed surface courses of the retread type during 1932, utilizing asphalt cut-backs, tar cut-backs and asphalt emulsions for comparison and mixing the surface to a depth of 2 in. with motor graders.

Macadam Surface Treatment—For initial treatment of bituminous-surface-treated macadam, the Pennsylvania highway department uses a total of ½ gal. per square yard of low-viscosity tar applied in two applications, followed by 20 lb. of commercial ¾-in. stone and rolled. For retreatment of this type surface specifications allow high-viscosity tars, asphalt cut-backs or asphalt emulsions, applied at the rate of ¼ gal. per square yard and subsequently chipped with 25 lb. per square yard of ¾-in. stone and rolled.

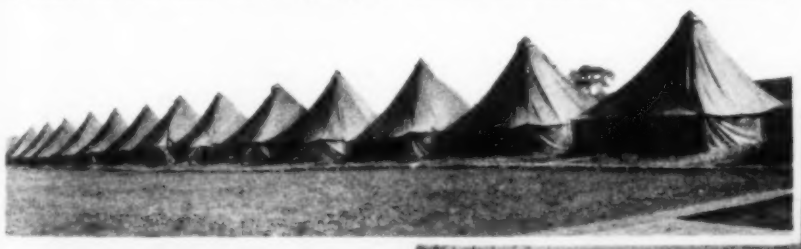
Highway Department Organization—Construction of the rural system is carried on by the maintenance division of the state highway department. By the reorganization plan of 1931 the number of highway districts in the state was increased from 8 to 12. Within the various districts each of the counties in the state has a state highway unit comprising personnel and equipment to take care of engineering, maintenance, and rural road construction in the county. Under the general direction of the district engineer, rural road construction in each district is supervised by a district maintenance engineer, with a county maintenance superintendent in direct charge of operations in each county.

Photographs appearing with this article illustrate typical construction operations in the Pittsburgh district, comprising six counties surrounding this great industrial center. Because of the large population in this district most of the rural roads are constructed of the more substantial types, such as bituminous-surface-treated macadam.

DRAGGING followed by rolling completes initial bituminous surface treatment of napped-stone base. Surface will be retreated following year, if necessary.



STEEL DRAG drawn by truck mixes and levels bituminous surface treatment on napped-stone macadam base course.



COUNTY LABOR CAMP housing total of 78 men is equipped with fourteen pyramidal tents, each containing six cots and a stove.

SLAG FOR BASE COURSE is distributed from trucks in half widths by two steel spreader boxes which are kept practically abreast. Note shoulder shaped to retain slag.

Spreading Work—To provide work for a larger number of unemployed two crews alternate on every project, each crew working 3 days a week. Only men with families or dependents are given employment, and the crews are recruited locally, the bare nucleus of a field organization being supplied by the highway department.

LIEUT. J. E. MURPHY *(left)*, National Guard of Pennsylvania, in charge of labor camp, and H. A. WHITEHEAD, Westmoreland County superintendent.

To take care of unemployed men residing at a distance from rural road projects, labor camps were established in seven of the larger counties at centers of construction activity. Men were sent to these camps for periods of 15 working days and then were returned home. The camps housed about 75 men and provided beds in tents and three good meals for 85c. a day. National Guard equipment was used, and the camps were efficiently managed on a semi-military basis. They were clean and sanitary and were as comfortable as they could be made with the equipment available. As the work near six of these camps has been completed, all but one have been abandoned.

Labor in most parts of the state receives 40c. an hour. Operations are carried on for 10 hr. a day in the summer and for 8 or 9 hr. during the shorter days of the colder seasons.

VIADUCT ROADWAY

Reinforced With Welded Bar Mats Is Concreted With Collapsible Frame Forms

LARGE shop-fabricated mats of welded bar-truss reinforcement and an ingenious and economical form system lent special interest to the construction of the reinforced-concrete deck on the $20,000,000 high-level viaduct across the meadows between Newark and Jersey City which the New Jersey State Highway Commission opened to traffic Nov. 24. The viaduct, which is about 3 mi. long, forms the last link in a direct overhead route between the Holland Tunnel and all highways to the west and south of Jersey City. It supersedes in large degree an inadequate road on the surface of the meadows which crosses the Passaic and Hackensack Rivers on low swing bridges. The new highway link crosses the two rivers on cantilever spans with a clearance of 135 ft.

BAR-MAT REINFORCEMENT for concrete deck is welded to cross-beams of steel frame.

Viaduct Design—The high-level viaduct superstructure, carried on widely-spaced piers, consists of deck-arch steel spans about 180 to 335 ft. long on land and of through-arch cantilever steel spans over the water. Each of the two bridges has a main span 550 ft. long anchored by 350-ft. end spans. A reinforced-concrete deck 50 ft. wide provides for five traffic lanes.

Panel lengths vary on different spans from about 22 to 27 ft. The concrete deck rests on the tops of the cross beams and girders, and the bar-truss reinforcement is securely attached to them by welding. Five intermediate 12-in. I-section cross beams are used between main cross girders on all spans, and the cross-beam spacing varies from about 38 to 56 in.

Reinforced-Concrete Deck — The deck slab is 8½ in. thick. The main reinforcement consists of longitudinal welded bar trusses on 8-in. centers. The trusses are just 2 in. short of being equal in length to the panel. 2-in. spaces being left to permit insertion of premolded mastic expansion joints in the slab. Transverse tie rods welded to the top and bottom chords of the bar trusses, as called for by the design, provided for fabrication into units 10 ft. wide. In addition, rectangular transverse bars were welded to the bottom of the mat at the proper spacing to rest on the top flanges of the steel cross beams. Mats weighed about 10 lb. per square foot, a typical 10x25-ft. mat weighing 1¼ tons.

Contractors—A general contract for the construction of the deck was awarded by the state highway commission to the Fredburn Construction Corp., of New York City. Reinforcement was purchased by the general contractor from the Kalman Steel Corp. The Fredburn Construction Corp. sublet erection and field welding of the reinforcement to the Taylor-Fichter Steel Construction Co., Inc., of New York City, and this firm, in turn, subcontracted the welding work to the J. K. Welding Co., Inc., of the same city.

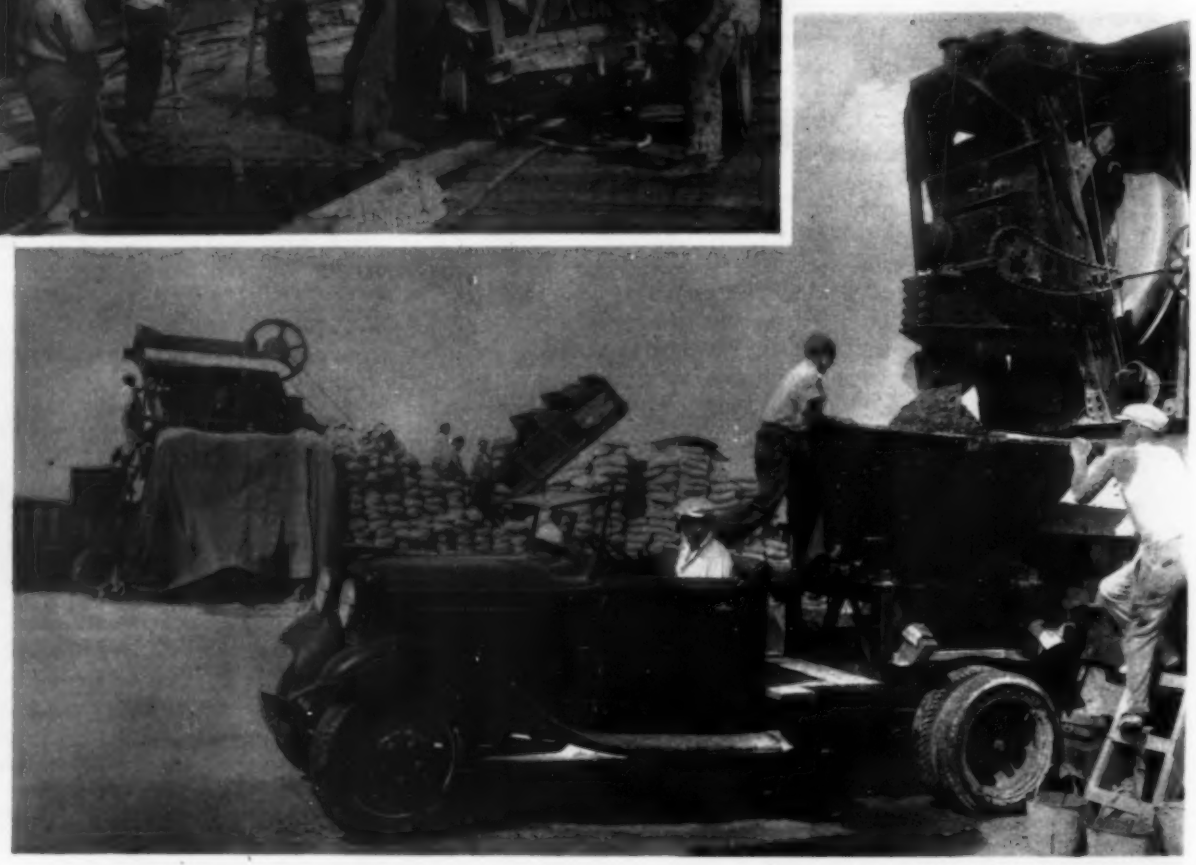
Reinforcement Erection — Reinforcing mats were trucked to the job and were erected by a traveling wood stiff-leg derrick and by a Universal truck crane. The two erecting machines started at the center of the project, where the general contractor intended to begin operations, and proceeded in opposite directions to the ends of the viaduct.

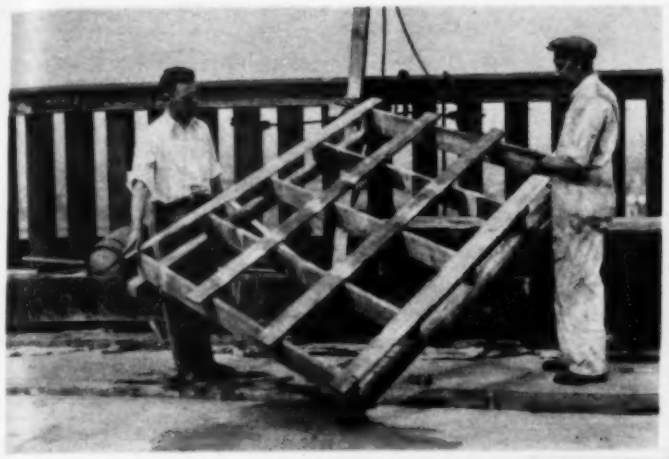
Welding Operations—Rectangular bars under the mats were welded to the main cross girders, at both ends of the mats, by ¼-in. full fillet welds 4 in. long on 8-in. centers. The design called for 1 sq. in. of fillet weld per linear foot of bar, to be deposited as 2⅝x⅜-in. fillets on 8-in. centers. At the request of the J. K. Welding Co., the engineers permitted the welders to deposit an equivalent amount of metal in longer and shallower fillets, as stated above. It would have been necessary to build up a ⅜-in.-throat fillet in two beads, and this process would have required cleaning of the first bead before depositing the second, as the welding contractor wished to use a covered electrode to increase welding speed.

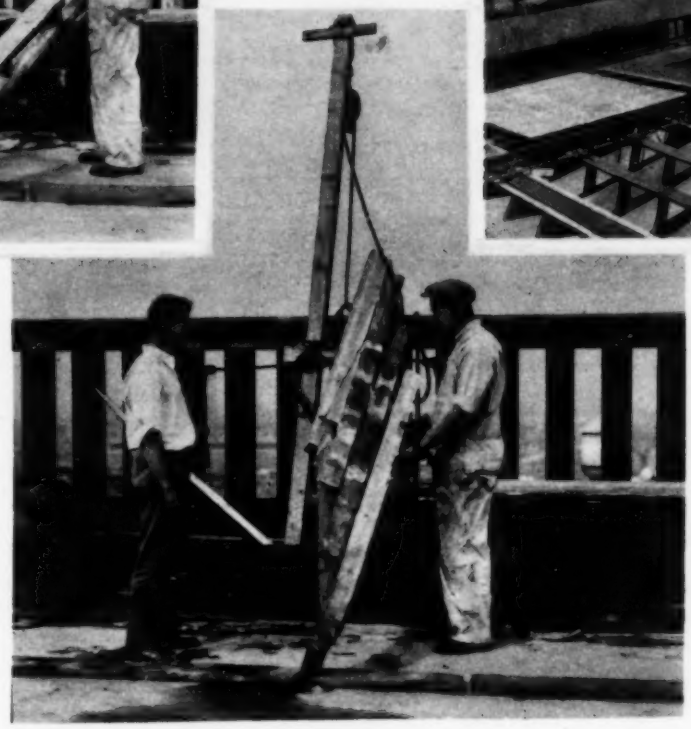
Tie rods at the top and bottom of adjacent mats were brought into contact and welded to one another to develop the full strength of the bars and make the reinforcement continuous across the width of the deck.

Operating an average crew of twelve welders, the welding contractor completed his work in 4½ months. A total of sixteen Lincoln gasoline-engine-driven 400-amp. 80/20-v. variable-voltage generating sets with rheostat voltage control up to 80 v. was kept on the job through-

TRUCK-MOUNTED HOPPER BODY *(left)* quickly discharges load of concrete into deck forms. TWO CENTRAL PLANTS *(below)* on deck, each equipped with 1-yd. paving mixer, supply concrete for deck paving.







COLLAPSIBLE WOOD FRAMES spanning between cross-beams (*at right*) carry plywood form surface. Frame fully expanded (*left*) and folded (*below*).

out this period. At times as many as eighteen machines were in use supplying welding current to an equal number of operators. All welding was done by the shielded-arc process, using Fleetweld ¼-in. covered electrode in 14-in. lengths. About 35,000 lb. of rod was required for the entire job.

Intermediate rectangular bars were welded to the cross beams with tack welds at 8-in. intervals. The rectangular bars resting on the main cross girders similarly were tacked to the girders prior to the fillet welding. Tack welds were about ½ in. long.

A typical 25x50-ft. deck panel called for 150 fillet welds (600 in.), 360 splice welds (720 in.), and 525 tack welds (262 in.). Exclusive of the tack welds, the design required about 1 in. of welding per square foot of deck surface. Welders on the fillet and splice welding averaged 1,045 sq. ft. of deck per man per day.

Concrete Forms—With the erection and welding of the reinforcement satisfactorily handled by subcontractors, the Fredburn Construction Corp. concerned itself chiefly with the concreting procedure for the 926,000 sq. ft. of deck. An ingenious form system was devised, consisting of collapsible frames of 1x6-in. wood joists which could be expanded to fill any of the various spans between cross beams and, when stripping was in progress, could be folded for removal from between the beams. When in position to support freshly placed concrete the frames were wedged securely between the flanges of the beams, as illustrated by several of the accompanying photographs. Wood wedges for this purpose were attached by chains to the frames.

Flooring strips to support the form surface were nailed to the tops of the wood joists as an integral part of the collapsible frame. The form surface consisted of ½-in. plywood panels laid after the frames were wedged in position and in no way attached to them. These panels were cut on the job to fit the various widths between cross beams. A treatment of special oil at the mill preserved the plywood surface for repeated use. About 100,000 sq. ft. of slab forms were employed on the job.

Concreting Procedure—Plans and specifications required the contractor to concrete one lane at a time. This method permitted the concrete crew to use forms for a 10-ft. width five times across the structure before bringing them up on the deck to move ahead and, also, facilitated delivery of concrete by trucks.

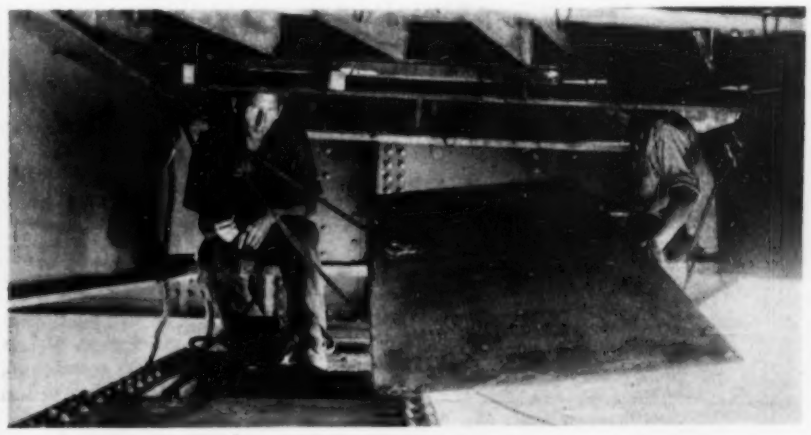
Truck haulage of concrete was suggested by the strength of the bar-truss reinforcement, which could easily carry 1-yd. concrete trucks on a 2-in. plank runway. By paving one lane at a time, trucks could dump concrete directly into place from the runway. After the concrete had hardened sufficiently, the trucks were able to haul over a paved lane in concreting the adjacent lane.

In paving one lane at a time, it was necessary to have dams along the edges of the lane to retain the concrete. The design called for ⅛-in. steel-plate dams to divide the lanes, these dams being welded to the outside truss or trusses of the mats as required to retain concrete. An exception to the steel-plate dam was made on each of the outside lanes, where the contractor used a wood form for the outer edge.

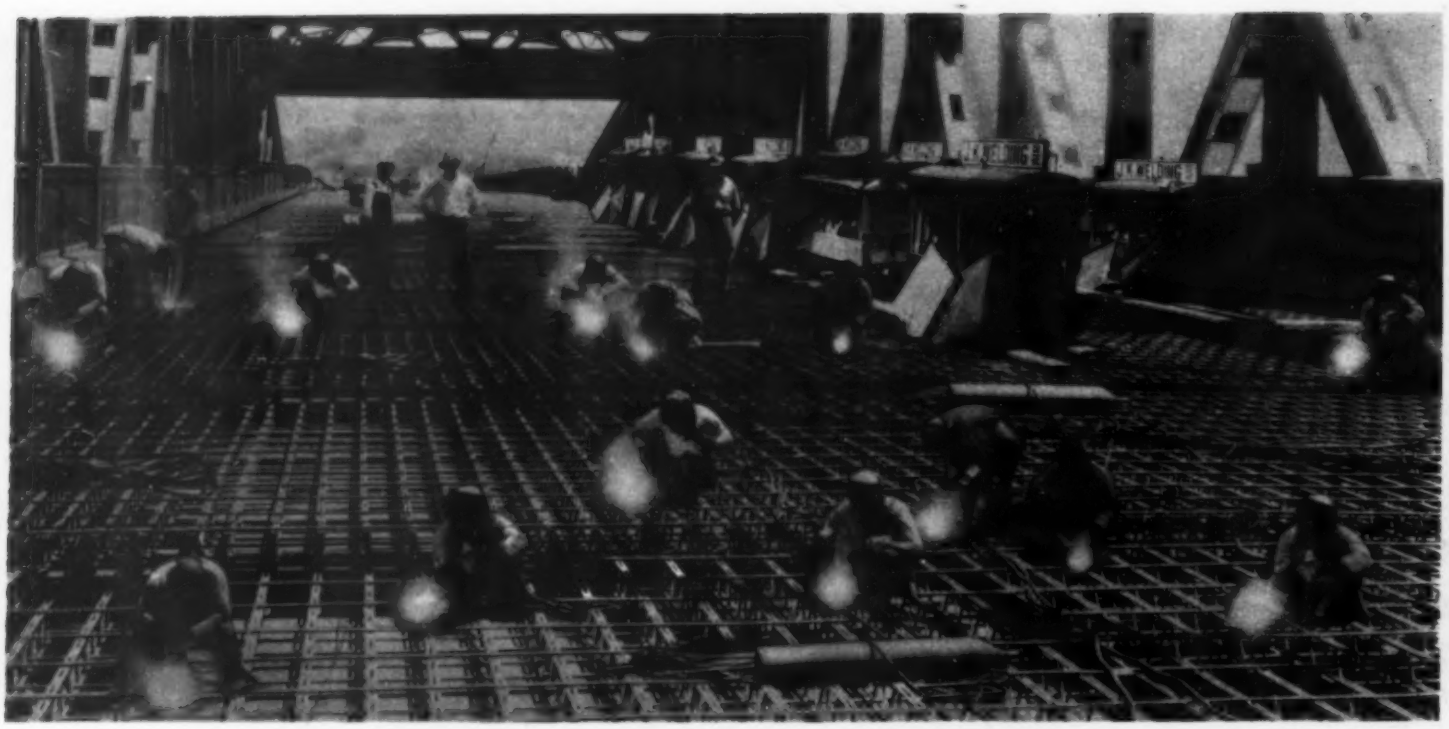
As the specifications called for 14 days' curing by means of an impervious paper covering and prohibited heavy traffic for 21 days, it was necessary to divide the job into four units of 4,000 ft. each. A section of this length allowed the required time for curing between operations without interfering with the daily progress of concreting. A weekly schedule of 4,000 ft. was adhered to, requiring average daily progress of 800 ft. for 5 days and leaving Saturday and Sunday for curing.

Concreting of the lanes was carried forward in a sequence which eliminated delays and reduced the labor of shifting forms. Let the five lanes be designated as: A, B, C, D and E. The plank runway was laid on lane C, and concreting progressed in this order: (1) B, (2) E, (3) D, (4) C, and (5) A. By paving B first, this lane was ready to carry traffic as soon as D was finished. Trucks running on B then could pave C (the plank runway having been removed) and A. By transferring forms from B to E on the first move, the plank runway remained in the same posi-

STRIPPING FORMS following completion of fifth lane of deck paving. Wedges locking collapsible frame between beam flanges are knocked out to drop frame, which then is folded for removal.



PLYWOOD PANEL, fitting between upper flanges of adjacent cross-beams, is stripped from under side of slab following removal of collapsible frame. Rope sling is used to hoist forms to deck.



FOURTEEN ELECTRIC ARCS weld bottom bars to cross-beams and splice transverse tie rods of adjacent mats.

tion to serve construction of both E and D, plank turnouts being laid at the point desired to place concrete in E and the trucks dumping directly from the runway into D. Shifts of the concrete forms involved four moves: (1) 30 ft., (2) 10 ft., (3) 10 ft., and (4) 20 ft.

Mixing and Hauling—Stationary mixing plants erected on the paved deck of the viaduct and supplied with batched aggregates were selected as the most economical means of producing concrete. These plants, unencumbered by aggregate storage bins and batchers, could be moved as required upon completion of a deck section to maintain an economical length of haul for the concrete trucks. The contractor used two plants, one equipped with a 1-yd. Ransome paving mixer and the other with a 1-yd. Smith paver. A supply dealer hauled aggregates to these plants from a special batching plant.

Paving operations started at a ramp near the center of the project. One of the mixers, set up on the ground at this point, supplied concrete for paving the ramp and the deck plaza at the top. Both mixers then were moved to the top of the ramp and set up on the deck. Truck fleets hauling from the two mixers paved in opposite directions from this point, each mixer providing concrete for 4,000 ft. of deck. After completing a 4,000-ft. section, each mixer moved to the end of the pavement and finished the deck construction from this position. The two mixing plants concreted a total of 1,600 ft. of 8½-in. pavement 10 ft. wide per day.

STEEL-SHOD WOOD STRIP fills space above steel-plate dam and provides rail for finishing machine.

Eight Ford trucks equipped with quick-discharging side-dump tip-over hopper bodies hauled concrete from the mixing plants. The mixers were elevated on platforms to discharge directly into the trucks. Hopper bodies for the trucks were built by the Blaw-Knox Co., according to the general contractor's design.

Finishing and Curing Slab—Concrete deposited by the trucks was consolidated in the forms by Gardner—Denver pneumatic vibrators supplied with air by an Ingersoll-Rand compressor. An Ord finishing machine surfaced the three inner lanes, steel-shod wood strips bolted to the reinforcement forming rails for the wheels of the machine. On the outside lanes, where a projecting structural steel curb prevented use of the finishing machine, the surface was finished with a pneumatic tamper and hand-operated screeds.

MECHANICAL FINISHER running on improvised rails surfaces 10-ft. lane.

Sisalkraft, an impervious waterproof paper, was used for surface curing. On the under side of the slab, the Hunt process of spraying asphalt emulsion was employed to protect the concrete during the curing period and to permit removal of the forms after 48 hr. The general contractor applied the asphalt with hand-operated spray bars, using Kellogg compressors and DeVilbiss spray outfits to atomize the emulsion.

Asphalt Block Pavement—A separate section 3,443 ft. long at the east end of the viaduct was paved by the Hastings Pavement Co., of New York City, and John Meehan & Son, of Philadelphia, who laid 13,950 sq. yd. of 2½-in. asphalt block and 5,180 sq. yd. of granite block, respectively, on reinforced-concrete base.

Administration—Gen. Hugh L. Scott is chairman of the New Jersey state highway commission. The Holland Tunnel approach viaduct was designed and constructed under the general direction of Jacob L. Bauer, state highway engineer. Col. H. W. Hudson, assistant construction engineer, was directly responsible for field and office operations, and S. Johannesson, designing engineer, was in charge of design.

For the Fredburn Construction Corp., W. S. Jones, general superintendent, supervised all operations. Samuel Kapelsohn, manager, was in general charge of erection of reinforcement for the Taylor-Fichter Steel Construction Co., and J. A. Klevens, president, directed the work of J. K. Welding Co.

PNEUMATIC VIBRATOR consolidates deck concrete. Mastic joint strip is wedged in place.

Florida Builds Roads With TAR-SAND SURFACE MIX

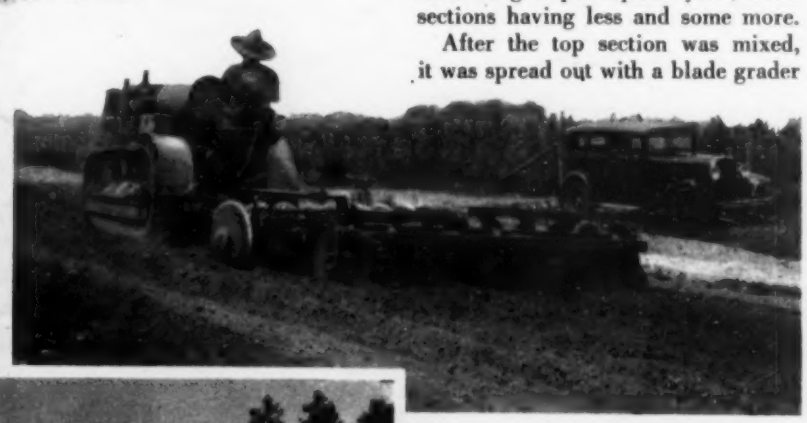
By GEORGE E. MARTIN

Consulting Engineer, General Tarvia Department, The Barrett Company, New York

ROADS in sandy areas present a difficult problem to highway officials. Such roads, built of the available sandy soil, are usually good in wet weather, but in dry weather they are unstable and easily cut up by traffic, often becoming almost impassable. The problem is complicated by the fact that other road building material, such as gravel or stone, is not generally found in these sandy areas.

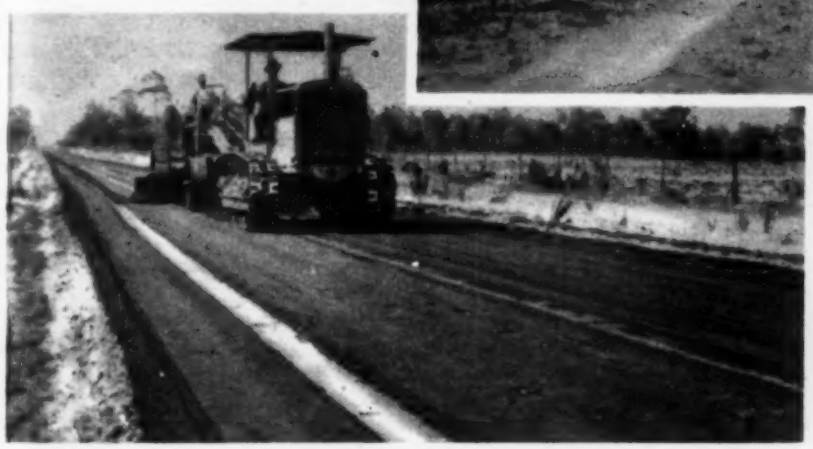
DISTRIBUTING TAR from tractor-mounted truck.

SAND ROAD *(right)* before grading.

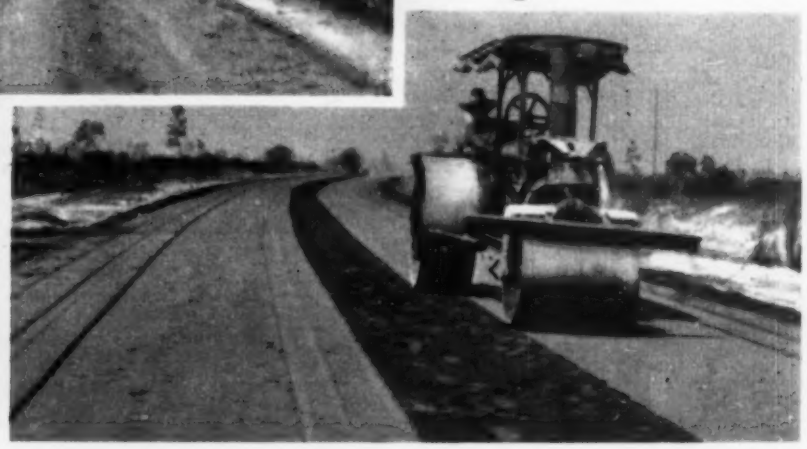


MIXING tar and sand with disk harrow.

SPREADING top section with blade grader.



FIRST ROLLING *(below)* with light-weight roller.



Last summer the Florida State Highway Department built a section of tar-sand highway immediately south of Bell, Fla. On this job the sand, as it existed on the road, was mixed with tar by machinery on the road surface and rolled in place. The sand in this section of the state is a typical white Florida sand. Except in a few sections where clay or lime rock had been added, it contained very little binding material in its natural state. The accompanying screen analysis is typical.

Tar—The tar used on the work was manufactured to have a specific viscosity at 60 deg. C. of 16-22. During the work the upper limit was raised slightly, and most of the tar shipped was at or near the upper limit. This grade of tar was satisfactory for Florida climatic conditions, but a somewhat lighter material would probably be better for average conditions. The following ranges in specific viscosity (Engler, at 50 deg. C.) have been suggested for general use: Light mixing tar, 16-22; heavy mixing tar, 26-36. If a still heavier material is required for hot climates, the consistency may be governed by the float test at 32 deg. C., with limits of 30 to 80 sec.

The work was started by plowing the sand for a depth of 10 in. and smoothing it with a grader. For construction purposes the road was divided into sections 3,000 ft. long. The tar was heated to 150 deg. F. and was applied at the rate of 0.35 gal. per square yard. This rate of distribution was generally used for the successive individual tar applications. It was necessary to pull the truck distributor with a crawler-type tractor to get through the loose sand. Immmediately after the application of the tar, a disk harrow, pulled by a tractor, started mixing the tar and sand. This disk harrow was kept working continuously between the tar applications.

The first application of tar was followed by others in the same amount until approximately 1.5 gal. per square yard had been applied and mixed into the surface. About 4 in. of this top mixture was then removed with a blade grader and piled in a windrow on each side of the road. Some tar had penetrated into the bottom or base section, but the major portion was retained in the mixed top.

Base—The application of the tar was now started on the base section and continued with successive tar applications and mixing until between 1 and 1½ gal. per square yard had been applied to the base course. After the mixing had been completed, the windrows of tar-sand mix were moved back over the base and additional tar applications started on the surface. These applications were also mixed immediately. It was the intention to have a lean base and sufficient tar in the top to form a wearing course. The total amount of tar used averaged about 4 gal. per square yard, some sections having less and some more.

After the top section was mixed, it was spread out with a blade grader and leveled off with an Adams retread machine. The tar then was permitted to set up before rolling. The first rolling was done with a "pup" roller and the final consolidation with a heavier tandem roller. Some sections of the road which appeared dry were given a light seal with the same grade of tar.

These construction operations produced a sand-tar mixture 6 to 8 in. thick. The top 3 or 4 in. contained about 2½ gal. of tar per square yard and the bottom or foundation layer about 1½ gal. per square yard. It is expected that surface treatments of tar may be needed, from time to time, to preserve the surface.

This work was done by the state highway department, B. M. Duncan, chief engineer, under the general direction of L. B. Thrasher, division engineer, with W. A. Hadley, project engineer in charge of construction. Equipment was rented by the state from the John E. Ballenger Construction Co.

SCREEN ANALYSIS OF SAND SAMPLES

Gradation Percent Retained (Sieves)					Percent		
	Percent Passing				Sand	Silt	Clay
10	10	40	80	200			
0.0	4.0	68.8	25.7	1.5	94.1	2.0	3.9

WHITE CEMENT TRAFFIC LINES

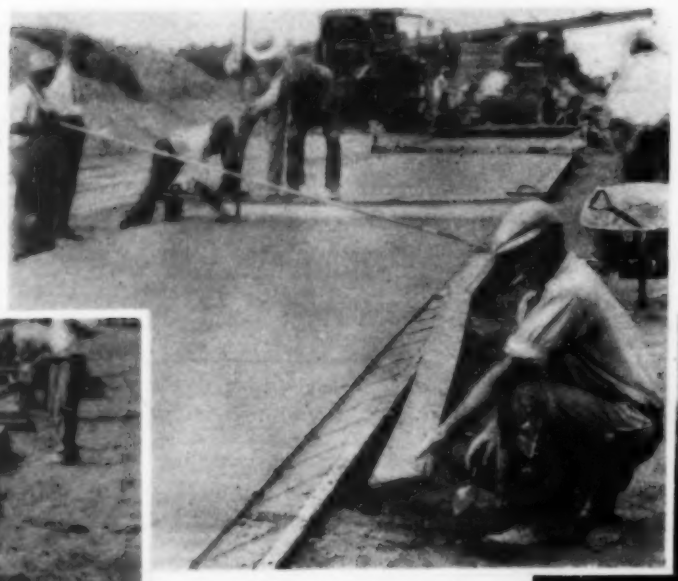
Built Into Pavement, Insure Permanence and Visibility

PERMANENCE and visibility for traffic line markings on state highways and city streets are being obtained by building into the paved surfaces inlaid strips of white portland cement mortar as a substitute for the temporary painted lines commonly used to guide vehicular movement. Painted lines, of course, involve a regular cost for maintenance, depending upon how often the obliterating effects of traffic and weather make it necessary to renew them. The white cement lines, on the other hand, are an integral part of the paved surface and require no special upkeep expense.

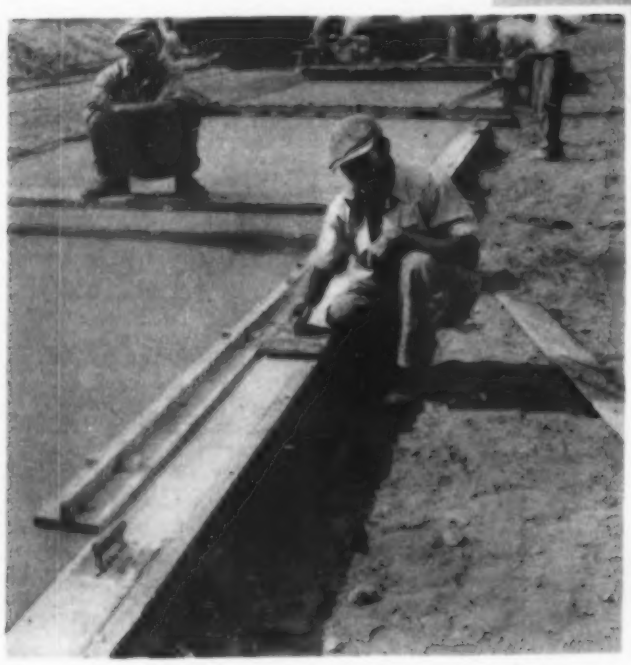
Painted Lines—The New Jersey Highway Commission, under the administration of Jacob L. Bauer, state highway engineer, has inaugurated a policy of marking newly constructed routes with inlaid white cement stripes. An investigation of painted traffic lines in that state indicated a cost for labor and materials of ½c. per linear foot of line (with paint at 78c. per gallon). Previously, with paint costing $2.40 per gallon the expense had been 1c. per linear foot. The necessary number of paintings on any highway per season varied according to the volume of traffic carried. Usually, it was found, traffic lines were painted two or three times a year, although certain heavily traveled routes, like the one between Trenton and New York, required from five to seven renewals of the painted lines each year.

For permanent inlaid white concrete traffic lines recent contract prices on New Jersey projects 4 miles or more in length have ranged from 3 to 6c. per linear foot. On this basis it appears that permanent lines can be installed for the cost of only a few paintings.

For inlaid white traffic lines in concrete pavement the New Jersey State Highway Department has prepared specifications containing the following provisions: Lines to be 6 in. wide and ¾ in. deep, constructed of



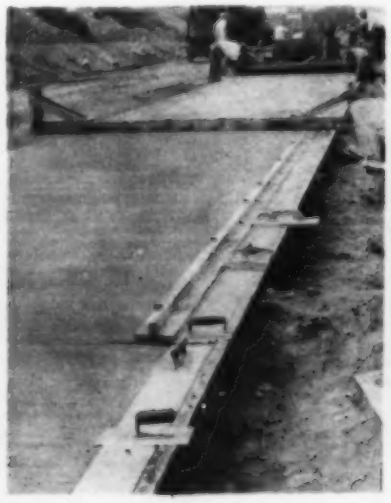
WOOD FORM, 6 in. wide and ¼-in. thick, has strap-iron cleats on bottom to form grooves for bonding white concrete to pavement slab.



FINISHING (*left*) is done with steel tool which dresses both edges and surface in one operation.

STRAIGHT-EDGE PROTECTOR (*right*) holds white concrete in traffic line channel.

COVER PLATES of sheet steel protect white traffic line while pavement is cured by bituminous spray.



SPECIAL TOOLS include floats, finishers, edgers and trowels.

FINISHED TRAFFIC LINE is white concrete strip 6 in. wide along gray concrete pavement lane.

white cement, white shiny sand, ⅜-in. concrete gravel and diatomaceous earth. Proportions of white cement same as those used in concrete pavement. Ratio of cement to ⅜-in. gravel, 1:2¼, with 2 lb. of diatomaceous earth used per bag of cement. Mixing period same as for reinforced concrete pavement.

Construction Details—Construction

CITY STREET INTERSECTION in Seattle is marked with inlaid lines of white concrete.

ON BRIDGE Seattle traffic is guided by permanently built-in lines of white concrete.

TRAFFIC MARKINGS on a thoroughfare are produced by white cement inlays.

procedure, as illustrated in the accompanying photographs, is as follows: After the paved surface is rough finished, a cavity is raked or spaded out to receive the traffic line forms. Each form is a cedar board 11 ft. 3 in. long and ½ in. thick, to which are bolted a strip of ⅛-in. sheet iron, on top, and ⅛x¾-in. strap-iron cleats on the bottom to form grooves for binding the white concrete to the pavement slab concrete. The forms are pressed into place by the final passage of the finishing machine and are accurately aligned parallel to the steel road forms or adjacent pavement edge.

After the passage of the finishing machine, it may be found necessary temporarily to remove the forms, displace pebbles which may have lodged between them and the steel road form or adjacent pavement edge, and replace the traffic line forms carefully in proper alignment. Where a double-flanged wheel on the finishing machine is necessary, a special traffic line form is used to provide wheel clearance between traffic line and pavement forms. After the pavement edge along the traffic line form has been dressed with an edging tool, the form is removed carefully to prevent marring the pavement edge. Then a wooden straight-edge protector with a steel lip along one side is placed along the side of the groove left by the form, preparatory to placing the white concrete.

Into this groove concrete made of Atlas white portland cement is spaded or rodded so as to bond the traffic line mixture to the pavement concrete. This work must be done carefully so that none of the gray cement of the pavement slab may penetrate to the surface and discolor the white concrete. A special wooden float, resting on the edge protectors and steel road forms, is used to press and compact the white cement into place and shape its surface to the pavement grade. The edge protectors are then removed. Final finish is given by a special steel tool which dresses both edges and the entire surface of the traffic line in one operation. This operation is delayed until the pavement and the traffic line concrete have set sufficiently to insure a clean-cut division and a smooth, dense surface.

WHITE CONCRETE CURBS, in addition to traffic line markings, are a feature of this highway intersection in New Jersey.

Curing—Where curing of the pavement proper is done by a bituminous surface application, steel cover plates about 10 ft. long and 7½ in. wide are placed over the traffic line to prevent discoloration of its white surface. It is necessary to join these cover plates closely and seat them properly in the cavity between the traffic line and the pavement so that no curing bitumen shall stain the white concrete.

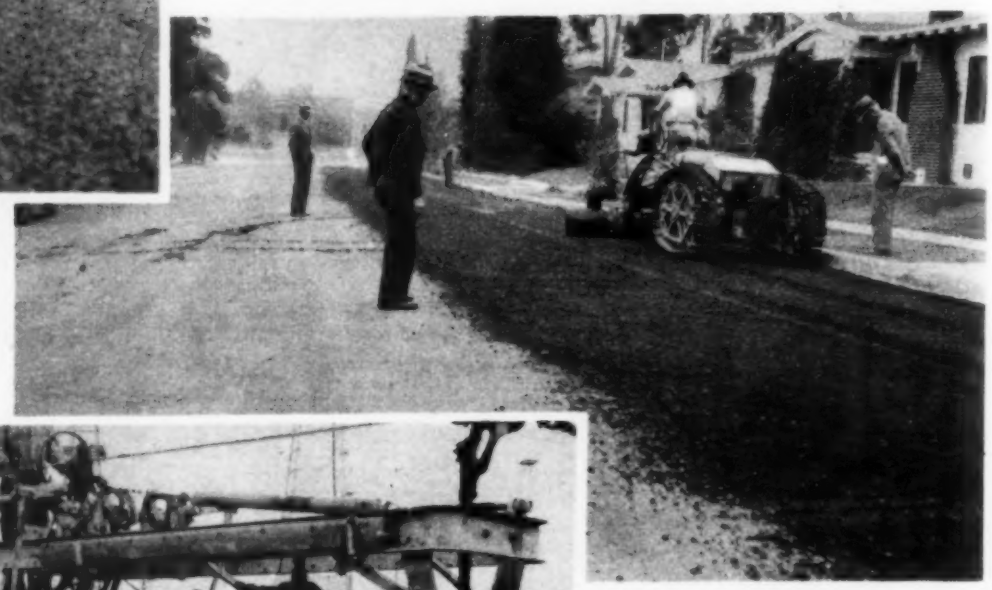
The curing of the white concrete is done with a colorless material, such as silicate of soda, applied with a rubber squeegee or soft bristle brush. Throughout the construction of the white traffic lines special care must be exercised to keep all tools and equipment clean.

For City Traffic—Among cities that have installed white concrete traffic lines extensively are Seattle, San Francisco and Los Angeles, on the Pacific Coast, in addition to Eastern municipalities which are developing the practice. In recent paving in San Francisco bituminous top surfacing on concrete base has been permanently marked for traffic by casting a raised band or curb of white concrete on top of the base slab. Similar construction has been used in Washington, D. C.

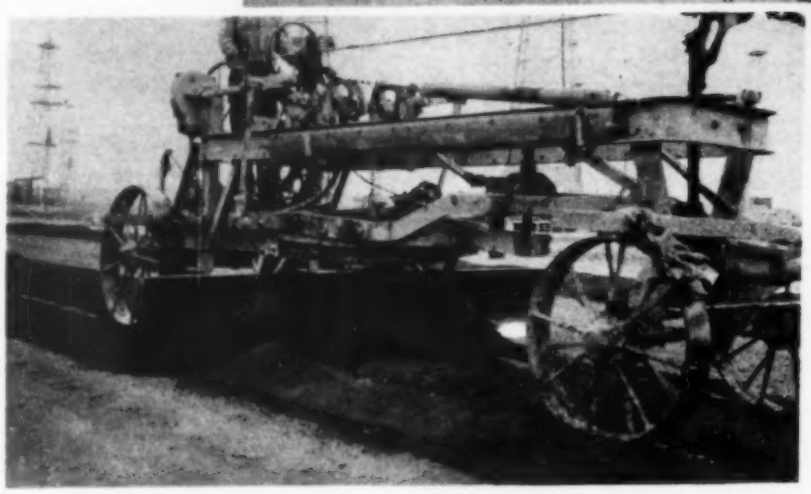
California Development Extends Use of

EMULSIFIED ASPHALT

Mixture employing preheated aggregate may be applied immediately or stock-piled for future use



PREMIXED SURFACING *(above)*, distributed uniformly by spreader box on rear end of motor truck, forms retread top.



TEXTURE of emulsion mixture is shown in pile ahead of grader blade.

BLADING the premix for resurfacing a residential street in Los Angeles.

PREMIXING heated aggregate and asphalt emulsion to form a mixture that may be either spread or rolled immediately or stockpiled for future use is a recent development, originating in California, which has been expanding rapidly in the field of maintenance work and resurfacing. The process presents the following advantages in the field of highway surfacing:

(1) Use of quick-breaking emulsion with fine aggregate to produce a dense mix. (2) Spreading with blade graders to eliminate hand raking. (3) Can be regulated to produce a mix that can be stockpiled and shipped by truck or railroad car. (4) Combines workability of a road-oil mix with stability of paving asphalt mixtures. (5) Permits contractors to use their asphalt plants economically for small units of work. The tonnage of this type of surfacing used for municipal streets, county roads and state highway work in the state has increased rapidly since the process was first introduced about a year ago, and the earlier jobs indicate satisfactory stability and wearing qualities. The city of Oakland has used 6,000 tons of this type of surfacing material in its street work and more than 10,000 tons have been used in Los Angeles and vicinity.

READY FOR ROLLING. Premix has been spread on half-width of highway prior to consolidation by roller.

Adhesion—The feature of this new method is the procuring of proper adhesion of the asphalt film to the aggregate by the setting of the emulsion in contact with the rock surface. The outer part of the emulsion coating acquires its set by subsequent evaporation after placing and rolling. The mix maintains its workability prior to final set, however, by means of the unbroken film of emulsion. The result is a mixture which handles easily during a prolonged spreading period.

The new process is fundamentally different from the process of mixing slow-breaking emulsion and cold aggregate. This practice which has been in use for many years, has had definite limitations, principally (1) the difficulty of using fine aggregate because of the tendency to ball in the mixer and (2) the tendency of the film of asphalt to strip from the surface of the aggregate during handling and rolling. Such cold mixtures, usually containing no aggregate smaller than ¼ in. size, require a seal coat application to protect the surfacing. The stripping tendency always has to be guarded against in cold emulsion premixes and is caused by several factors including water in the aggregate and dust films which prevent close contact and adherence of the asphalt to the metal. The new process was developed through laboratory research directed toward the overcoming of these difficulties.

Aggregate Heated—The new method involves the heating of the aggregate before mixing. The heat produces a dry surface on the stone and quickly sets the interior layer of the emulsion coating sufficiently to produce tight adhesion. With proper control of temperature, the outer part of the coating on each piece of aggregate maintains its emulsified character. This process is usually carried on in a standard asphalt plant, where equipment for heating, batching and mixing is available, but is readily adaptable to concrete mixers by the addition of a drier unit.

If the material is to be used at once, the heat control is regulated to break more of the emulsion coating with the result that the mixture

stiffens more rapidly on the job. On the other hand, it is possible by keeping the heat low, to produce only enough set on the inside of the emulsion coating to obtain adequate adhesion so that the remaining layer of emulsion permits stockpiling for weeks. It is possible to stockpile the material near the plant, where it can be picked up, when needed, by clamshell buckets and transported by trucks or gondola cars to the point of use. In other cases it can be trucked directly from the plant and stockpiled along a section of high-

ROLLING compacts the mix and produces a uniformly textured surface requiring no seal coat.

STOCKPILE *(left)* of premixed material, after weeks of storage, is loaded by clamshell bucket *(below)* into trucks. Views illustrate workability of material.

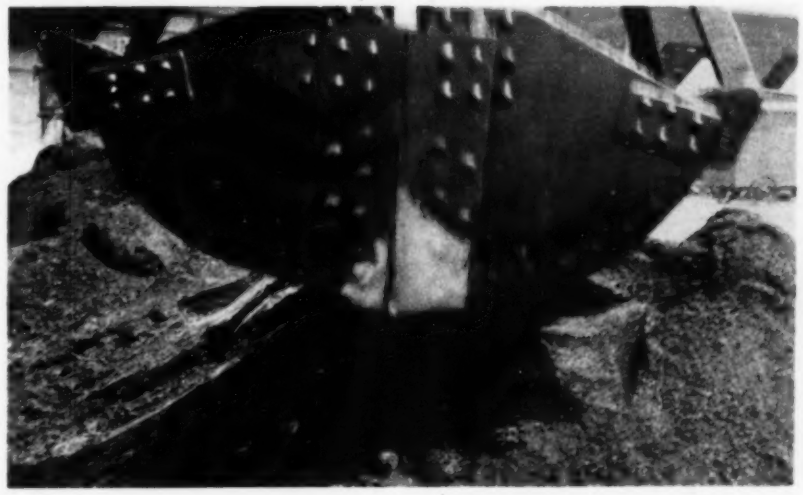
way for maintenance or patching operations.

A particular advantage of this mixing operation is the possibility of using fine aggregate grading to obtain densities comparable to sheet asphalt or closely graded asphaltic concrete. The use of fine graded aggregate mixed cold with slow-breaking emulsion is impossible, as previously mentioned. A typical grading of aggregate used for the new process appears in the accompanying table.

Mixing—The mixing operation is simpler than that required for the ordinary hot asphaltic mixes. The rock and sand from stockpiles are heated in the usual type of revolving drier to a temperature of about 200 deg. F. and then elevated, screened and batched into the pug mill. The

TYPICAL GRADING OF EMULSION PREMIX

Screen Sizes	Per cent Passing
200	0.5
100	4.7
80	8.9
50	16.6
40	22.3
30	25.4
20	28.7
10	35.7
¼ (3)	41.4
½	100.0
¾	
% Emulsion	5.7
% Asphalt	3.1



emulsion at atmospheric temperature is then added and mixed for 45 to 60 sec., producing a uniformly rich brown colored mixture. The mixing liberates some vapor, and the temperature of the batch is lowered.

On arrival at the job, if the material is to be used immediately, it spreads easily from the end gate of the truck leaving the body shiny clean. After spreading, a one-man grader can be used to blade the mixture to the required thickness and cross-section. The blade handles the mix readily and the gradual cooling does not cause difficulty even though manipulation continues until the material is cold. After spreading, the mixture is rolled and opened to traffic immediately. During rolling, the mix material gradually turns black and presents a firm, uniform textured surface which requires no seal coat.

The same spreading methods are used, even if the material has been previously stockpiled. No difficulty is experienced in handling the mix, even though a thin crust may have formed on the outside of the pile.

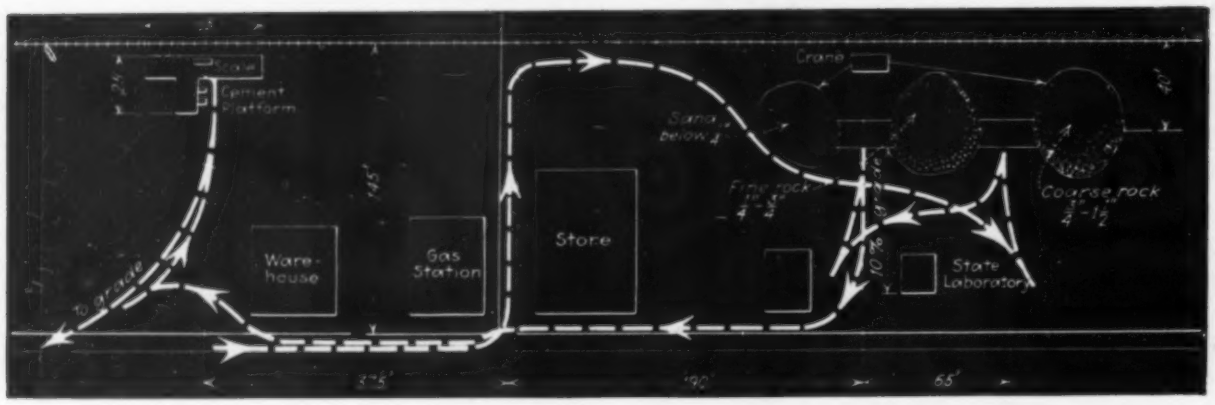
This process has a particular appeal to contractors in various communities who have asphalt plants. The operation of such plants is not economical except for large jobs and their capacity prohibits the feasibility of using them for small maintenance work. The new process permits their operation for short periods to procure stockpile material which can then be sold to the municipality or other agency for patching and maintenance work, or used by the contractor for small contracts. Even such short runs of the plant are not difficult because little preparation is required. Heating of the rock, of course, is a continuous process which starts with the plant, and the use of the cold emulsion eliminates the usual preliminary heating of the asphalt tanks.

This process was developed and has been carried forward through the research work of the technical staff of the American Bitumuls Co., San Francisco, Cal.

TEXTURE *(below)* of finished surface after rolling. Comparative sizes of material in mix indicated by latch key.

How to Increase Efficiency at the BATCHING PLANT

From a report by
ANDREW P. ANDERSON
Highway Engineer,
Division of Management,
U. S. Bureau of Public Roads



AWKWARD ARRANGEMENT of material-handling yard demands tortuous routing of trucks, with 90-deg. turns and backing of vehicles at three points. Single crane handles three sizes of aggregate. Yard time constant for two-batch trucks, 333 sec.

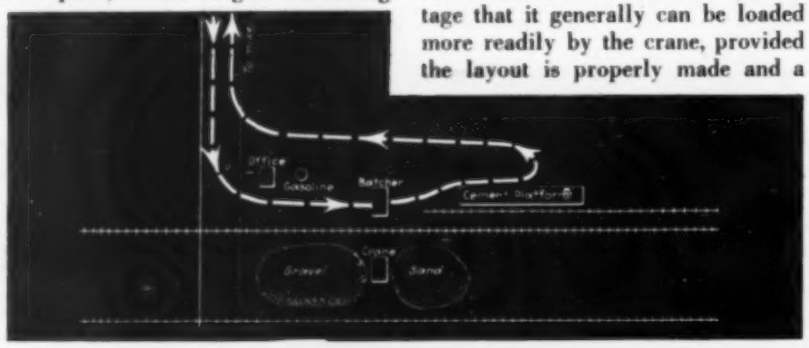
IN THE portable paving outfit, the mixer is the chief producer with which all equipment, operations and procedures must be properly coordinated to produce high operating efficiencies and low unit costs. This fundamental principle applies with particular emphasis to the batching plant, through which all principal raw materials must pass.

Essential functions of the batching plant or loading yard are three: (1) To receive the incoming stone or gravel, sand and cement, and provide for these materials such storage as may be necessary to meet the continuous demands of the mixer; (2) To form or combine the materials into unit quantities of the size and the proportion required for the batch at least at the rate and with the regularity demanded by the mixer; and (3) to provide for the transfer of these batches or unit quantities into the hauling units with the least possible delay or interruption to the primary function of the trucks, which is to transport the batched materials from the loading yard to the mixer.

Batching Equipment—To supply a 27E paver capable of producing at a maximum rate of from 45 to 55 batches, or from 50 to 70 yd., of concrete per hour, a usual batching plant consists essentially of a crane with a 1- or 1¼-yd. bucket, one or two bins equipped with batch-weighing devices, and a cement loading platform or cement bin, all generally located at a railroad siding where there is room for ample stockpiles. If sack cement is used, it usually is necessary to have also a cement shed with a capacity of at least 1 day's supply.

In general, the crane should have a capacity of not less than 1 or 1¼ cu. yd. and should be capable of maintaining a regular cycle of not to exceed 25 sec. per load from stockpile to bin when working at an angle of about 90 deg. From cars to bins the crane should be able to maintain an average cycle of not to exceed 30 sec. Such a crane should easily be able to keep up with the mixer, even at maximum production, if permitted to work the coarse aggregate from cars to bins.

If all materials must first go to stockpiles, some night unloading probably will be necessary when mixer production is high. Speed of crane operation can be increased by working on a runway about 6 or 7 ft. high, built up of coarse aggregate, enabling the operator to see into the cars.



SHORT, STRAIGHT-THROUGH CIRCUIT for batch trucks reduces loading time at yard handling only two sizes of aggregate. Yard time constant for two-batch trucks, 135 sec.

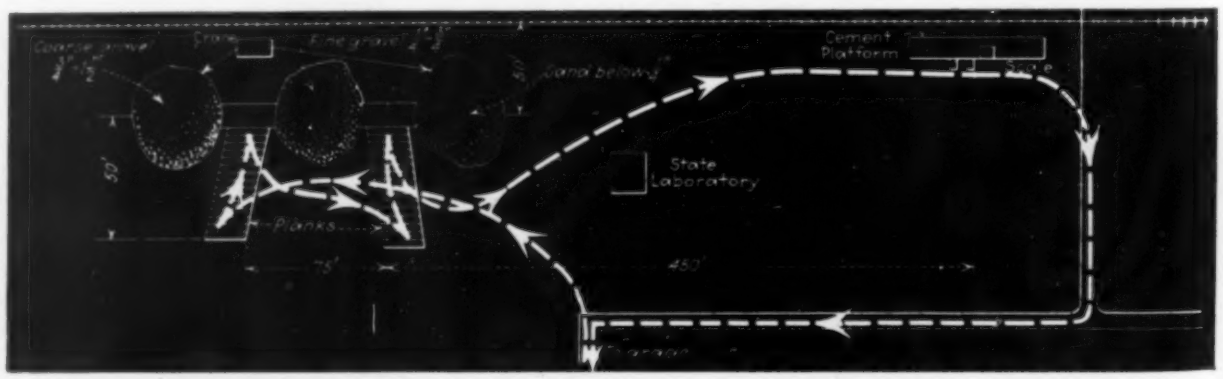
Two Sizes of Coarse Aggregate—If the coarse aggregate is of two sizes, a three-compartment bin should be used in preference to two individual bins. Two bins generally add from ½ to ⅔ min. per batch to the time constant of the trucks. The three-compartment bin prevents this time increase and has the further advantage that it generally can be loaded more readily by the crane, provided the layout is properly made and a convenient power unit is available for moving the cars. Moving the crane from one bin to the other usually consumes more time than is lost in keeping three cars within reach for loading into a three-compartment bin. The capacity of any bin or set of bins should be at least sufficient for 1 hour's run of the paving mixer.

Cement Handling—Sack cement sometimes is loaded directly from the car, but it is preferable to construct a platform from which the bags can be dumped directly on to the truck. The cement platform should be so designed that the bags can be dumped readily from hand trucks without any rehandling. For this purpose, the platform must be about 6 in. higher than the truck body and so located that the truck can drive close along the side. The alternative method of tossing the bags by hand ordinarily requires from 10 to 15 man-seconds per bag.

At present bulk cement commonly is handled in two-wheel buggies, of either the end or bottom dumping types. Efficiency requires that the platform be long enough to unload from two cars simultaneously. A canvas boot extending to the point of deposit in the truck and a 2-ft. wall around the dumping point are needed to prevent cement losses. For best results, the buggy tracks on the part of the platform extending over the truck should be hinged and counterweighted to lift the canvas boot clear of the truck when no buggy is on the tracks.

In hot weather, loading the buggies is trying labor, and the number of shovelers must be sufficient to afford frequent rest periods. On fast jobs a total of 6 men usually is employed on the cement in addition to the weight inspector. Time studies on two jobs have indicated an average cycle of 200 man-seconds per buggy load of 630 lb. of cement.

When bulk cement is used, the time constant of the trucks—i.e., the average total time spent by the truck during each round trip in activities other than the actual hauling of the load to the mixer and returning empty to the yard—generally is increased somewhat. The amount of the in-



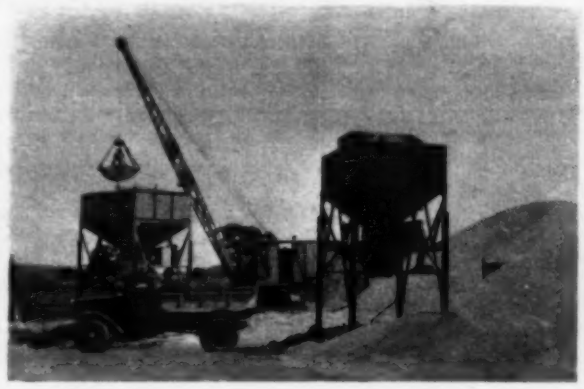
IMPROVED LAYOUT of batching plant handling three sizes of aggregate with one crane involves backing under two aggregate bins and straight-through loading at bulk-cement platform. Yard time constant for two-batch trucks, 231 sec.

crease depends on the method of handling the cement. Three general methods are in use in various sections: (1) Placing the cement in between aggregate, as, for example, coarse stone, sand, cement, and finally second-size stone; (2) dumping cement on top of the batch and covering with a canvas tarpaulin; and (3) carrying the cement in a special container on the truck.

Mechanical Cement Plant—Equipment for the mechanical handling of bulk cement is used by many contractors. It would seem desirable that the size of the bin used with these plants be enlarged to provide sufficient capacity for 1 full day's run, thus doing away with the necessity of using bag cement as emergency storage. The bin should be erected to permit a drive straight through, to help keep down the time constant of the batch trucks. The average operating cycle of a typical mechanical cement-loading plant is 27.7 sec., of which 17.2 sec. is for filling the hopper and 10.5 sec. for dumping into the truck.

Such losses are not to be looked upon lightly. In fact, an occasional delay, averaging only 1 min. each hour to the mixer, is likely to be as expensive as a regularly occurring delay of 1 min. to each truckload out of the yard. The first and most essential object of the material plant therefore must be to facilitate regular, continuous operation of the hauling units well within the time intervals set by the mixer.

Time of Yard Operations—Every maneuver or operation within the yard requires time. To complete the usual 90-deg. turn and back the truck under the bins ordinarily consumes from 20 to 30 sec. With good batching facilities the actual standing time for a truck in taking on one batch of sand and coarse aggregate may regularly be as low as 10 sec. and need rarely exceed 20 sec. Subsequent batches require more time, as the truck must wait while the batch is weighed out, and this operation ordinarily requires from 20 to 30 sec., provided the sand flows readily. From 20 to 40 sec. usually will have to be added for each additional batch. Where it is necessary to back under the bins, the use of two bins instead of one for loading the sand and aggregate is found to increase the yard time constant of the trucks about 40 to 50 sec. for one-batch trucks, 75 to 90 sec. for two-batch trucks, and from about 100 to 125 sec. for three-batch trucks, under fair to good management and operating conditions.



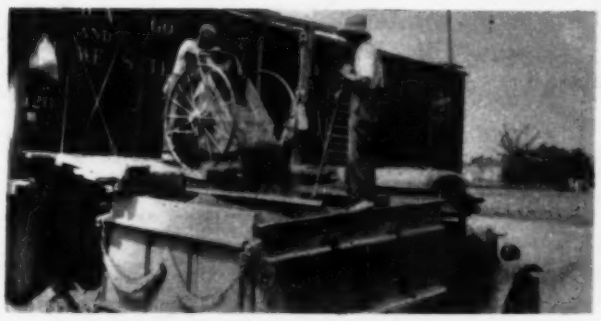
TWO BACKINGS under bins by batch trucks could have been avoided by turning bins for straight-through drive. Time consumed by trucks in turning and backing increases yard time constant.

WELL-PLANNED LAYOUT of aggregate-handling units provides straight drive through two bins, with crane and stock piles on opposite side of track. Crane works on elevated runway made of coarse aggregate.

BULK-CEMENT LOADING PLATFORM long enough to unload from two cars simultaneously reduces interference and facilitates cement handling.

TWO-BATCH TRUCK receives supply of bulk cement in 7 to 7½ sec. by simultaneous dumping of two buggies. Boots reduce blowing and spillage.

Mixer Delays—Costly as are the faults which increase the time required for serving the hauling units, those faults or conditions of yard layout, arrangement, or equipment which contribute to the irregularity of operation are more to be dreaded. Any irregular delay to the trucks at the loading plant is likely also to be imposed on the mixer, and mixer delays are far more expensive. While a regular loss of truck time costs anywhere from 2 to 5 c. per minute, delays to the mixer entail a cost of about 75 c. or even $1 per minute.



AVOID THESE MISTAKES in handling bulk cement: platform long enough for only one car, no boot to prevent blowing or spilling of cement, space to dump only one buggy at a time in loading multi-batch truck.

BOTTOM-DUMP CART and canvas boot reduce wind losses in handling cement. Platform should be extended to permit unloading from two cars at a time, thus speeding up this operation.

THREE-COMPARTMENT BIN and plank retaining walls for stock piles reduce amount of space necessary to handle two sizes of coarse aggregate.

ELEVATED CRANE RUNWAY, formed by extending and leveling part of stockpile, gives operator clear vision into railroad cars and speeds up unloading operation.

If the drive is straight through, these figures generally can be reduced by from 20 to 40 sec.

Driving speed within the yard is low, seldom more than an average of 250 to 400 ft. per min. The average yard seems to have a yard loop or circuit which requires about 1½ min. for the actual driving. Individual yards, however, vary greatly in length of the yard circuit, and even more in the driving conditions. Thus yards have been found which had a driving time as low as 35 sec. and others as high as 5 min.

CEMENT-BOUND MACADAM
for Secondary-Road Construction

AS A result of present interest in low-cost roads and of the excellent record made by grouted-stone pavements laid years ago, the last 8 months have seen a revival of this type of construction after a lapse of almost 10 years. From 1906 to 1923, large yardages of grouted-stone pavement were laid in a score of New England cities. In 1921, the street railways of Detroit laid 375,000 sq. yd. of grouted-stone wearing course on track pavement. The grouted-stone construction used in those years was patented and was named Hassam pavement after its inventor.

Recent investigations of grouted-stone pavement from 10 to 25 years old in a number of cities disclosed the fact that all of the pavement now in existence is in excellent condition. During the last 10 years, and particularly in the last 5, this type of pavement has been widely built in continental Europe, Great Britain, and Australia. The study of existing sections in the United States convinced several highway engineers that the grouted-stone construction deserved a new trial in this country. As a result of their efforts, five experimental sections were built in 1932.

Purposes of Construction—No attempt was made on these sections to produce a true concrete pavement. The object of the construction is to build a stone macadam pavement the voids of which are filled with a sand-cement mortar binding the whole into a rigid mass. Cement-bound macadam has been generally accepted as a descriptive name for this type of pavement. A mosaic surface, exposing the tops of the stone, is desired for wearing and traction.

Low first cost and low maintenance are the primary claims for cement-bound macadam, which must be met if the pavement is to gain general acceptance. The method of construction does not produce a high-type pavement satisfactory for trunk routes, and the cost must be kept down if cement-bound macadam is to meet the requirements of secondary roads. On the five projects thus far built, it has been demonstrated that 6-in. pavement can be constructed for less than $1 per square yard.

SAND-CEMENT GROUT of sufficiently thin consistency to penetrate to bottom of pavement is broomed into voids, filling stone flush with surface and leaving top fragments exposed.

DISTRIBUTOR HEAD, with bolted cover plate removed, reveals inner vanes and bottom openings, each about 1¼ in. square, which discharge vertical streams of grout upon surface of stone.

TRUCK MIXER applies grout to stone by means of distributor head attached to end of chute, which is swung back and forth across road as truck moves ahead. Brooming completes distribution of grout and removes excess mortar from surface.

Equipment—An important factor in the success of this type of construction is the truck mixer or truck agitator. It is essential that the grout be uniform and fluid at the time of delivery to assure penetration of the stone, and this end is best served by keeping the mortar in motion on the vehicle which transports it. Truck mixers were used on all the experimental projects. Invention of auxiliary devices to improve the construction and reduce costs already is in evidence, the first example being a grout distributor box attached to the end of the mixer chute.

Experimental Projects—Of the projects built in 1932, Morris County, N. J., constructed two 500-ft. sections of 6-in. pavement 18 ft. wide; Somerset County, N. J., laid 700 ft. of 6-in. thickness 20 ft. wide; the Pennsylvania department of highways built 1 mi. of 6-in. pavement 18 ft. in width; and the New York state department of public works constructed 1 mi. of 6-in. slab 18 ft. wide. With minor exceptions, the 6-in. thickness was uniform throughout the cross-section of the slab on all projects. Some departures from this thickness occurred on the first experimental section constructed (in Morris County, N. J.), where the builders failed

to make sufficient allowance for compaction of the stone under the roller, and on the Somerset County section, where an excess of stone increased the thickness to 7 in. A 100-ft. section on the Pennsylvania job was built with an 8-6-8-in. cross section to test the value of thickened edges.

Construction Procedure—Four of the projects were built by county and state highway forces; only the New York job was constructed by contract. The general procedure on all projects was about as follows: On a shaped and rolled subgrade crushed stone of uniform size was spread and compacted by an initial rolling. Truck mixers distributed grout, which was broomed by workmen to fill the stone flush with the surface. A second rolling soon after the grout was placed aided the filling of the voids. Before the grout had taken its initial set, final surface corrections were made by forking stone out of high spots and depositing additional stone in depressions. A final rolling compacted the surface while the grout was taking its initial set. The surface then was finished by brooming or hand belting and was cured with wet hay or burlap.

CONCEALED JOINTS formed by fastening 1x2-in. wood strips to subgrade control transverse and longitudinal center-line cracks in completed slab.

Spreading Stone—Stone of uniform size was recognized as desirable to prevent segregation and to eliminate clogging of the voids. Stone passing a 2¾-in. and retained on a 1½-in. screen probably gives the best results, although a 2 to 3½-in. stone was used on two projects with satisfactory results. An effort was made to eliminate rock passing the smaller screens in order to prevent clogging of the voids. Experience on the five projects indicated that an allowance of 20 per cent should be made for compaction of stone and loss in the subgrade. A 7½-in. loose depth compacted to 6 in. under the roller. To avoid excessive rolling of the stone and accumulation of foreign matter from the grout trucks, it was found desirable to spread stone only one day's run ahead of the grouting. Crushed trap and crushed limestone were used in the experimental work.

Dummy Joints—Wood strips 1 in. wide by 2 in. high, fastened to the subgrade with nails, were used successfully in the old Hassam pavement to control longitudinal and transverse cracks. The same dummy-joint construction gave good results on several of the projects.

Grout—Voids in the stone approximated 40 per cent on all projects. A mix of 1 part cement—2 parts sand was used for most of the work, although richer mixes were applied in short portions of several projects for comparison. The 1-2 mix is generally regarded as satisfactory for cement-bound macadam. Water content was increased to 5 gal. per sack of cement in hot weather to 7 gal. per sack for pavement constructed at temperatures around 40 deg. F., when evaporation was slow.

DEPRESSIONS indicated by straight-edge are filled with ⅛-in. stone from piles alongside road. Grout is added where necessary.

SPREADER BOXES for half-widths of road, resting on subgrade and pulled forward by trucks, offer most efficient means of distributing stone to proper depth One-size stone is used to prevent segregation and clogging of voids by small particles.

A constant, uniform flow of grout is important if efficient penetration is to be obtained. On the first experimental project, grout was discharged by the mixer chute directly on the stone. Grout deposited in this way had a tendency to float the stone. As a result of this experience, a distributor head was devised for attachment to the chute which discharges the grout in multiple vertical streams. The chute is swung to spread the grout as the truck moves ahead. Only enough grout is applied to fill the voids flush with the surface of the stone.

Rolling—A tandem 8-ton or 10-ton roller has proved to be one of the best types for compacting the stone before the grout is distributed. A thorough rolling to assure full compaction and obtain a smooth surface should precede the grouting. The rolling immediately after grouting brings some mortar to the surface. Excess surface mortar is swept into the voids or off the road, to leave the stone exposed. Iron hand tamps were used on the experimental projects along the edges or in other places which the roller could not reach.

10-TON ROLLER goes over pavement after grouting to facilitate penetration and to bring mortar to surface for finishing. Roller also compacts stone prior to grouting to obtain consolidation and prepare smooth surface for slab.

Leveling Surface—Projecting stones and surface irregularities of the cement-bound macadam pavements were ironed out with hand floats or removed with forks. Slight depressions were filled with ⅝-in. stone and major low spots with the larger stone. Where necessary, the truck-mixers added grout. Rolling of the surface continued until these spots were consolidated.

Finishing Surface—A minimum amount of mortar to provide a smooth surface remained on top of the stone after the leveling operations. Finishing consisted usually of two steps. Two men first belted the surface by hand, using a strip of wet folded burlap as a belt and working it forward with a sawing motion. As a final operation, a strip of wet burlap clinging to the surface was drawn forward to remove any waves left by the belting. These methods produced a surface with no variations greater than ½ in. under a 16-ft. straightedge.

Curing—Wet hay or straw covering the surface protected the slab during the curing period. The pavements were opened to traffic in from 4 days to 2 weeks, depending upon the weather conditions.

Construction Speed—Operations on the experimental projects showed that an average rate of construction of 1,000 ft. a day can be obtained. Because of the novelty of the work, progress in the first few days on any project was less than this amount; but on the longer sections the speed quickly increased to the figure named.

Core Tests—Cores drilled from the completed pavements of several projects showed complete penetration to the bottom of the stone and gave compression strength averages of 3,000 to 4,000 lb. per square inch at 28 to 33 days, as corrected in accordance with the proper A.S.T.M. formula for cylinders of a height less than twice the diameter. The cylinders broke cleanly through the aggregate in the testing machine.

Helps to Successful Contracting

Fourth of a series of articles on applying business principles to construction and making profits by avoiding costly mistakes

By HARRY O. LOCHER

IV—Construction Equipment and Methods

RIGHT methods go hand in hand with right equipment for successful contract work. A few years ago a newly organized contracting firm were low bidders on a highway contract. With a confidence not justified by their limited experience, they plunged in, bought what equipment they thought was needed and proceeded to use it without any well-thought-out plan of operation.

For a time they breezed along, with a feeling that everything was going well. They had put several shovels into good, heavy excavation and for a while the estimates looked fine. After they began to get into the light work, however, they discovered that considerable re-handling was necessary. This, that and the other thing didn't work out right. Within a month estimates changed from amounts more than sufficient for monthly operations to less than enough to carry them. A loan from a local bank carried them for a month or so longer, but when they attempted to increase this loan they were unable to do so.

They then sought additional finance from an institution in another state which had furnished them with funds at the beginning, through the intercession of a well-known and competent attorney who was a friend of the contractors and also of certain officials of the lending institution. But this institution hearing what was happening to certain highway contractors, would put up no more money. Instead, they called in the attorney and said: "You got us into this mess, now get us out of it."

Curing a "sick" job— The attorney accepted the challenge. Realizing his own lack of experience, he consulted the state highway engineer and asked him to recommend a man competent to aid in straightening out the situation. Fortunately, a particularly able man was available, and was employed. Then, with note books and a camera, the attorney and his construction associate visited every highway contract of importance in the state. They observed methods; they studied equipment; they talked with contractors and superintendents—all the time making notes and sketches, and taking pictures. They spent two weeks at this work. Then they returned to the "sick" job and studied it for a few days.

The attorney was no construction man (he should have been), but he had a nimble, observing, adaptable mind. After making this close study of the "sick" job he and his construction adviser worked out a method for doing what was left of it, a method that took advantage of every natural aid and permitted no lost motion in the sequence of operations. Equipment that did not fit its job precisely was disposed of—this was easy to do, as the state was full of work. New equipment that would handle the work with the least expense was bought or rented. They resumed operations (the work had been shut down) and the contract was completed at a modest profit.

A contractor with a national reputation has often told the writer that it is cheaper to do work in an orderly and methodical manner than by hit-or-miss, slovenly methods which seem to be economical. Economy and savings usually follow right along in the wake of method and orderliness. In addition, morale and interest of employees are raised by order and method and go hand in hand with them. The reverse, also, is true.

Importance of Equipment— In these days of generous terms by equipment manufacturers, availability of rental equipment and fast-moving improvements in equipment, it is sometimes a perplexing question whether to buy, rent, or use what you may have. With prices low and competition super-keen, the equipment used is a major factor. One of the best known levee and drainage contractors in the country once told the writer that with the low prices for work in his field he couldn't possibly compete unless he used equipment that was up to the minute and nearly ideal for the work in hand. He said further that, with from one to maybe a dozen pieces of idle equipment which would *almost* fit the job, he had, time and again, built or purchased new equipment that *exactly* fitted it.

Of course, there are conditions and classes of work that would qualify this situation. The main point is that, on some classes of work, the type of equipment used often means the difference between profit and loss. Competent contractors, or their superintendents, if they will painstakingly study the situation, can usually come to the right conclusion. The trouble is that the situation is usually treated too superficially. The drilling, blasting and mucking methods in the Yonkers to Brooklyn Catskill water tunnel, and in the river diversion tunnels at the Hoover Dam, are examples of modern equipment and bang-up methods that make for fast work and economy. Too often methods which include old equipment on hand (this being the only reason for its use), prove disappointing and uneconomical. This is due sometimes to obsolescence, sometimes to dilapidated condition, sometimes to both. Then the situation is hopeless.

I recall one old-time subcontractor who agreed with a general contractor to do a certain portion of a job that had been awarded. The subcontractor was to rent and use equipment belonging to the general contractor. The old subcontractor happened to be at the station when the local shoved the four or five carloads of equipment in on the siding. It was rusty, dilapidated, obsolete. Our subcontractor climbed aboard the cars, looked over the contents with more curiosity than interest, made various and sundry "comments," finally concluding with, "I bet Noah used that old winch on the Ark." Then he made his way to the general contractor's office and told him that he had changed his mind and would prefer to have a job as superintendent.

Purchase or Rental— Certain kinds of work, in certain quantities and locations, can be most economically done by rented equipment. This is a problem that can be solved only by careful study. As a general rule, rented equipment is on the job a great deal longer than was originally anticipated. In view of the irregularity of most contractors' work and the amount of idle equipment on their hands much of the time, it would seem that there is a field, as yet only partly developed, for the equipment rental business, operated on a high plane, possibly by manufacturers themselves. This method of equipment handling might be effective in lowering costs on some classes of contract work and in simplifying one of the uncertain items of cost, depreciation.

There is a wide difference of opinion as to how depreciation should be figured and included as cost—all the way from not including it at all, to the most intricate systems. Any prudent contractor, however, knows that depreciation is a major item of cost. Those who don't usually have little else than a yard full of junk to show for a lifetime of effort.

Another factor in running up costs and causing delays is failure to provide emergency equipment, such as pumps for unusual water conditions, either sub-surface flows or heavy rains; or extra buckets. It often happens that a perfectly good orange-peel, clam-shell or dragline bucket is dropped into a pit and put completely out of commission, pending repairs at the shop. There should be an extra bucket ready to hook right up. A good, economically managed shop, of a size fitted to the job, is a time and money saver.

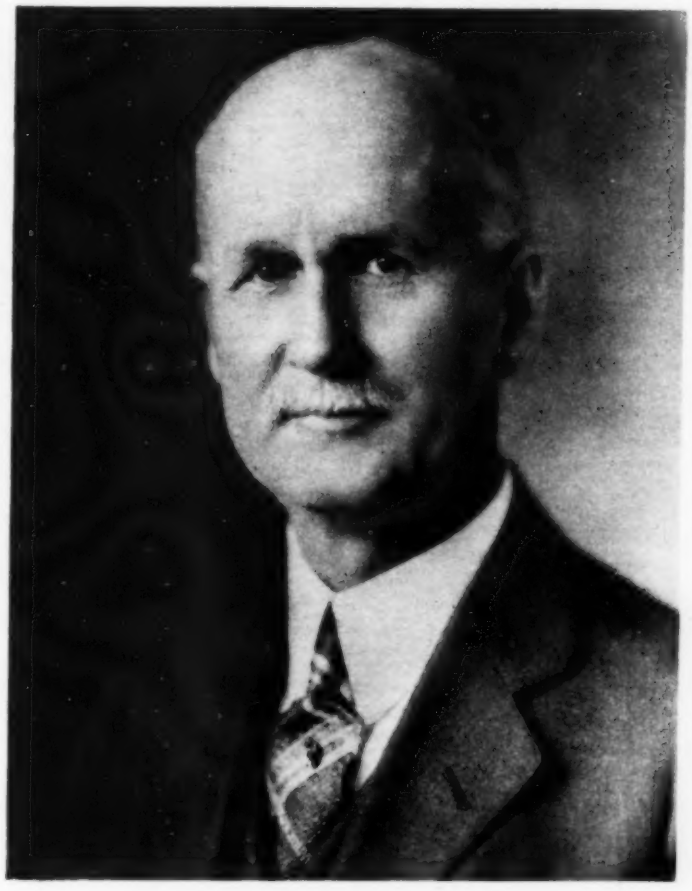
Standardization— On one large construction job, using six power shovels, there were five different makes among them. This is expensive equipment management for several reasons: First, it necessitates carrying four or five times as many extra parts as would be necessary if the shovels were all of one type, provided, of course, they were of the same size. Second, an operator may be skillful on one make of machine and not so good on others; a shifting of operators may materially slow up output. Again, cables may be of different sizes and lengths, entailing added cost. When a shovel is properly managed, extra cables of the right size and length are kept on the machine ready for immediate use.

It is difficult to discuss, separately, equipment in itself, and equipment as it relates to costs and methods. Well-chosen equipment and carefully worked out methods cannot but result in lowered costs—the vital thing in contract work. Too much work is done by rule-of-thumb method, or because it has always been done a certain way. Methods and equipment are improving every day, with a resulting lowering of costs and an increasing volume of work per unit. Contractors and their superintendents and foremen must keep posted up to the minute as to what is going on. Years of well-seasoned experience are valuable, good judgment is fine, but unless experience and judgment are kept fresh by information on the latest developments in equipment and methods, you are soon outbid by those who do keep posted.

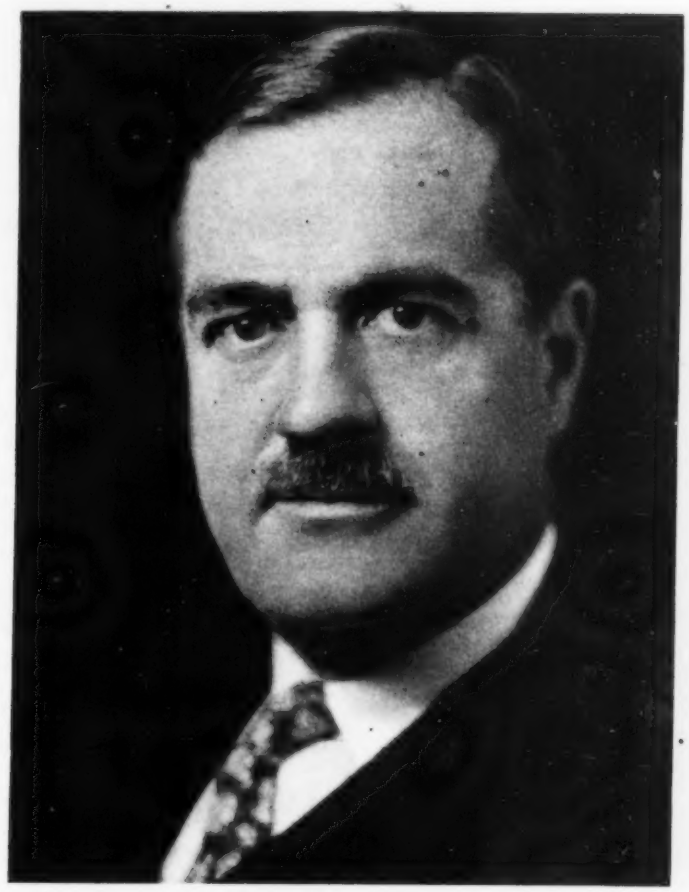
NEXT MONTH: "Selecting an Organization"

Present and Accounted For —

A Page of Personalities



HONORED BY ENGINEERS. Alonzo J. Hammond, consulting engineer, Chicago, will become president of American Society of Civil Engineers at its annual meeting in New York this month. After a number of years devoted to railway and municipal engineering in Indiana and Illinois, he became assistant chief engineer for the $75,000,000 Chicago Union Station. Later,, he served as chief engineer for James O. Heyworth, Inc., on hydro-electric design and construction and as chief engineer for the Mellon-Stuart Co. on a large-scale internal improvement program in Cuba. He is now in private practice as consulting engineer in Chicago.



CONTRACTORS' LEADER FOR 1933. Arthur C. Tozzer, executive vice-president of the Turner Construction Co., New York, is the newly elected president of the Associated General Contractors of America. His connection with the Turner organization dates back to 1905, when he served as superintendent and later as general superintendent and vice-president in charge of the company's New England work. His selection as the organization's executive vice-president occurred in 1928. Mr. Tozzer's construction experience covers more than 300 projects, mostly buildings, including the $28,000,000 Army Supply Base in Brooklyn.

HEADS N. Y. ROAD BUILDERS. Fred B. Davis, highway contractor of Utica, N. Y., has been elected president of the New York State Highway Chapter of the Associated General Contractors of America. He was formerly vice-president of the organization.

VICE-PRESIDENCY FOR TEXAN. Associated General Contractors of America select A. J. McKenzie, of Dallas, president of the McKenzie Construction Co., of that city, as second in command of the national organization. He built the $2,250,000 Smith-Young Tower, San Antonio's tallest building.

HIS EXCELLENCY, NOW. Henry H. Blood, former chairman of the State Road Commission of Utah and past-president of the American Association of State Highway Officials, was elected Governor of Utah, on the Democratic ticket last November.

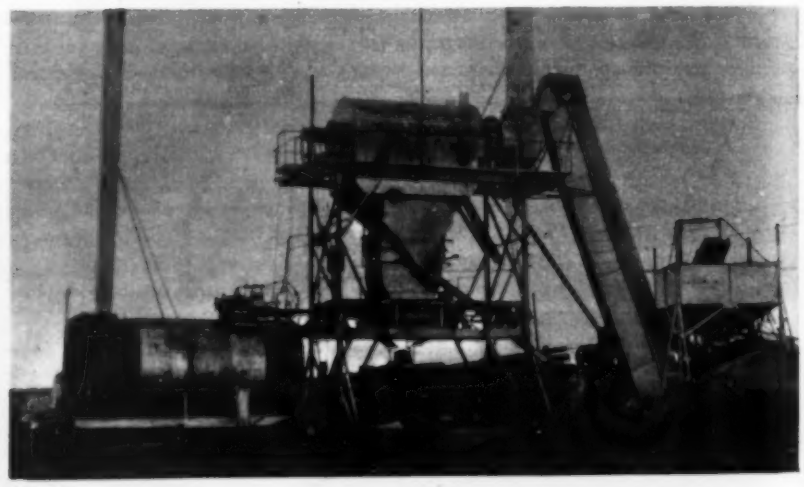
NEW EQUIPMENT ON THE JOB

ASPHALT SPREADER *(right)* attached with chains behind truck, will cover width of 9 ft. — or more, if adjustable end gates are opened. Long, smooth runners insure level action of spreader and uniform distribution of material. Depth of spread controlled by self-locking screw adjustment easily operated. Strikeoff blade arranged in four sections permits adjustment to form any desired crown to road. Made in two sizes: 8- and 9-ft. widths. Will also handle stone, slag and concrete —Galion Iron Works & Mfg. Co., Galion, Ohio.

CABLE TENSION INDICATOR adds new feeler gage for determining exactly when instrument is in correct position on cable for accurate reading. Device consists of knurl-edged disk fitted beneath V-blocks which receive cable. As clamps are tightened, disk may be turned freely until correct pressure is applied, when action of disk is automatically retarded. Improvements on heavy-duty type indicator include micrometer deflection adjuster and saddle adjuster.—Martin-Decker Corporation, 3431 Cherry Ave., Long Beach, Calif.

12-IN. SAW for maintenance and repair work. Specially fitted for sawing 1-in. lumber and will cross-cut up to 2x12's in dressed lumber. Saw blade 6 in. in diameter cuts to depth of 1⅞ in. Saw base vertically adjustable for depth of cut. Apron-type safety guard covers blade when not in use. Powered by ⅓-hp. Universal motor for a.c. and d.c. current, voltage as required. Weighs 8 lb. Standard equipment consists of one combination rip and cut-off blade and 15 ft. of two-conductor rubber-covered cord.—Skilsaw, Inc., 3310 Elston Ave., Chicago, Ill.

9-YD. CARRY-ALL SCRAPER *(below)* is designed to pick up and transport large load easily and quickly. End gate, which hangs forward and up from bucket, is actuated by cable from power control unit forcing earth from front of blade into bucket. Load is raised and carried away in high gear. Load discharged by forcing end gate to rear while moving in high gear.—R. G. Le Tourneau, Inc., P. O. Box 1513, Stockton, Calif.



SELF-CLEANING WAGON TRACKS *(right)*, for use with any make of track wagon. Four-point support for each track is provided by two end wheels and two truck wheels enabling loaded wagon to be moved easily with minimum of power. Track shoes of heavy pressed steel. Links drop-forged and heat-treated. One-piece frame made of welded steel plates rigidly braced by steel ribs supports truck, track wheels and end wheels.—Tractor Division, Allis-Chalmers Mfg. Co., Milwaukee, Wis.

PORTABLE ASPHALT PLANT (Madsen) for preparing and mixing materials for asphalt, bituminous concrete, oil-mixed and cold-laid pavements. Consists of mixing, asphalt heating and boiler units with set of wheels interchangeable among them for transportation. Electric power, diesel or gasoline engine drive. Feature of plant is asphalt gun which forces weighed quantity of asphalt cement into mixer when operator moves control valve. Operated by three men. Stationary models for city and county paving.—Blaw-Knox Co., Pittsburg, Pa.

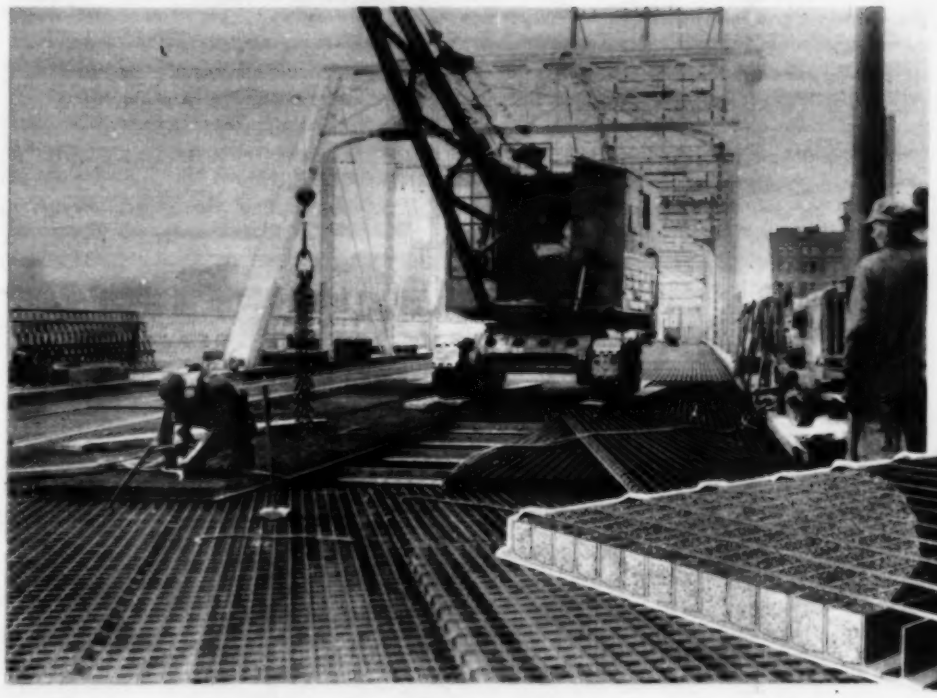
If You Want Further Information—

Within the space limits of this page it is impossible to present complete information about the products illustrated.

The manufacturers, however, will be glad to supply further details if you will write to them.

TEEGRID Floor System

PATENT APPLIED FOR

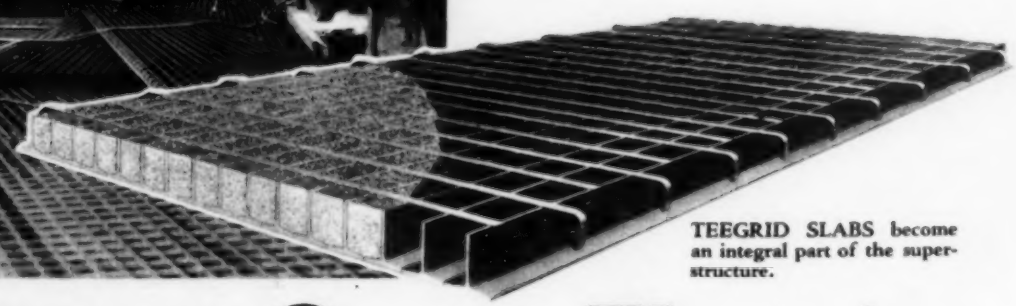


FOR BRIDGES—

Increases strength — decreases dead load — simple rapid erection — greater rigidity — no forms required — quickly opened to traffic — steel armored wearing surface resists traffic abrasion and prevents skidding.

Also used for Warehouse or Pier Floors, Truck Scale Platforms, Highway Gutter Covers.

Write for our Teegrid Handbook.



TEEGRID SLABS become an integral part of the superstructure.

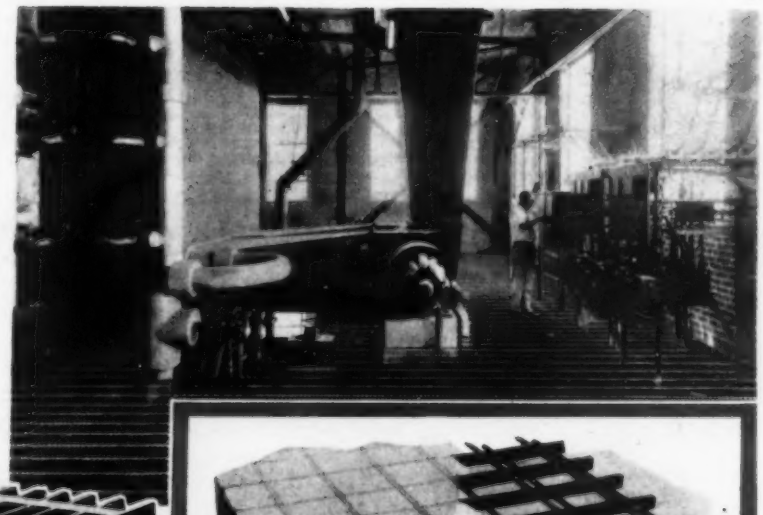
PLATEGRID Open Flooring

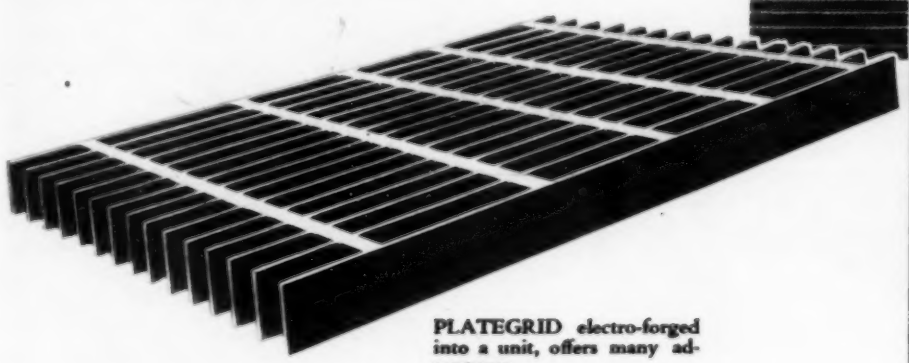
PATENT APPLIED FOR

Furnished in various types, sizes and finishes to meet exact requirements for an all-steel grating as an efficient open type flooring. A one-piece construction permitting maximum passage of light and a minimum resistance to the flow of air; free from cuts, rivets or mechanical joints — no sheared edges or holes. The uniform openings make it impossible for debris, dirt, snow or ice to collect.

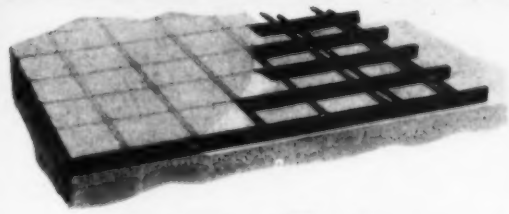
Plategrid Open Flooring is successfully and economically used in power houses, pumping stations, water works, refineries, gas plants, sewer disposal plants, foundries and industrial plants, for floors, walkways, platforms, sidewalks and stair treads.

Catalog on request.





PLATEGRID electro-forged into a unit, offers many advantages.



FLOORGRID

PATENT APPLIED FOR

An excellent wearing surface for heavy duty floors. The unit is embedded in concrete or a mastic fill and gives maximum protection.

TRUSCON

TRUSCON STEEL COMPANY, YOUNGSTOWN, OHIO

Turn night into day

with

NATIONAL CARBIDE V.G.LIGHTS

The National Carbide V. G. Light

—is economical:—can be operated intermittently without waste
—spreads a full, even beam of 8,000 candlepower right where you need it—double candlepower when extension is used
—lights up the job for twelve hours on one 7-pound charge of National 1-ND Carbide and 7 gallons of water
—and is easily handled by one man, with nothing to get out of order. No harm done if it tips over. Just stand it up again.

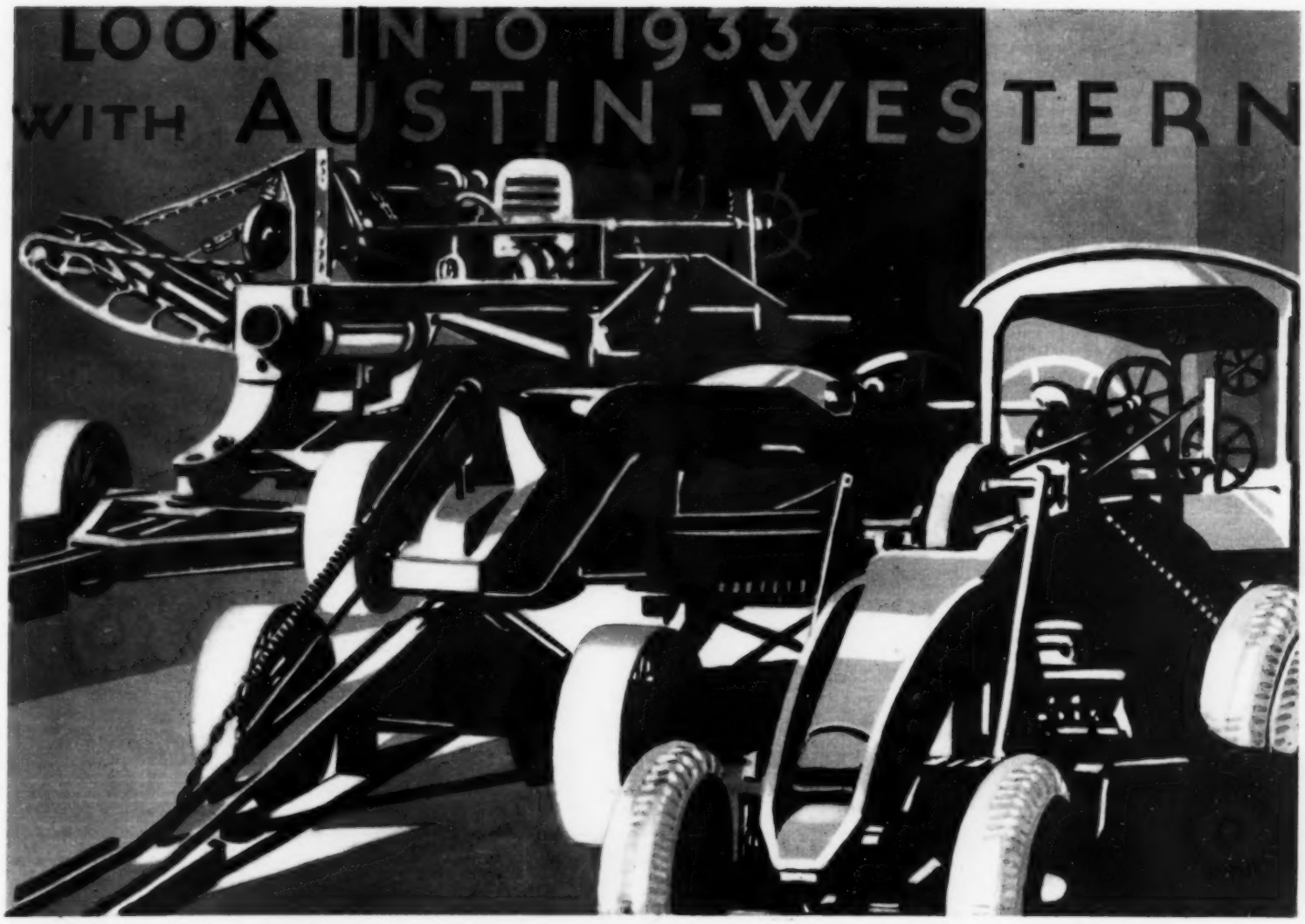
The HANDY LIGHT *supplies 1500 c.p. for 5 hours and only weighs 23 pounds.*

Weight 53 lbs. empty, 96 lbs. when full

Write for booklets on the V-G Light, the V-G Handy Light and Lantern

NATIONAL CARBIDE SALES CORPORATION

LINCOLN BUILDING, Opposite Grand Central, NEW YORK



NEW Equipment with NEW Improvements for NEW LOW COST Operation

ROAD SHOW
See our exhibits at the Highway & Building Congress, Detroit, January 16 to 20

◆

Not just new models! The problems of 1933 are not to be solved by compromises with past practices.

Drawing to the full extent, upon the resources of 75 years of leadership—Austin-Western has achieved advances that make possible a new era of LOWER COSTS in road building and maintenance.

Months of engineering development, grueling operating tests, and finally costly factory retooling—have all been undertaken with confidence that a solution to present-day economic demands could be attained.

These important developments can save you money in 1933, or make your money go farther. Write for full information to be released shortly.

The Austin-Western ROAD MACHINERY CO.

ROAD ROLLERS, CRUSHING & SCREENING PLANTS, SCARIFIERS, SWEEPERS & SPRINKLERS, ROAD GRADERS, ELEVATING GRADERS. MOTOR GRADERS, PLOWS & SCRAPERS, BITUMINOUS DISTRIBUTORS DRAGS, SHOVELS & CRANES, DUMP WAGONS, SNOW PLOWS.

400 N. MICHIGAN AVE., CHICAGO - - - BRANCHES IN PRINCIPAL CITIES

Barrett Tarvia

GOOD ROADS at LOW COST

Allentown-New Egypt Road, near Cream Ridge, New Jersey. Tarvia-built, 1930.

The Barrett Company

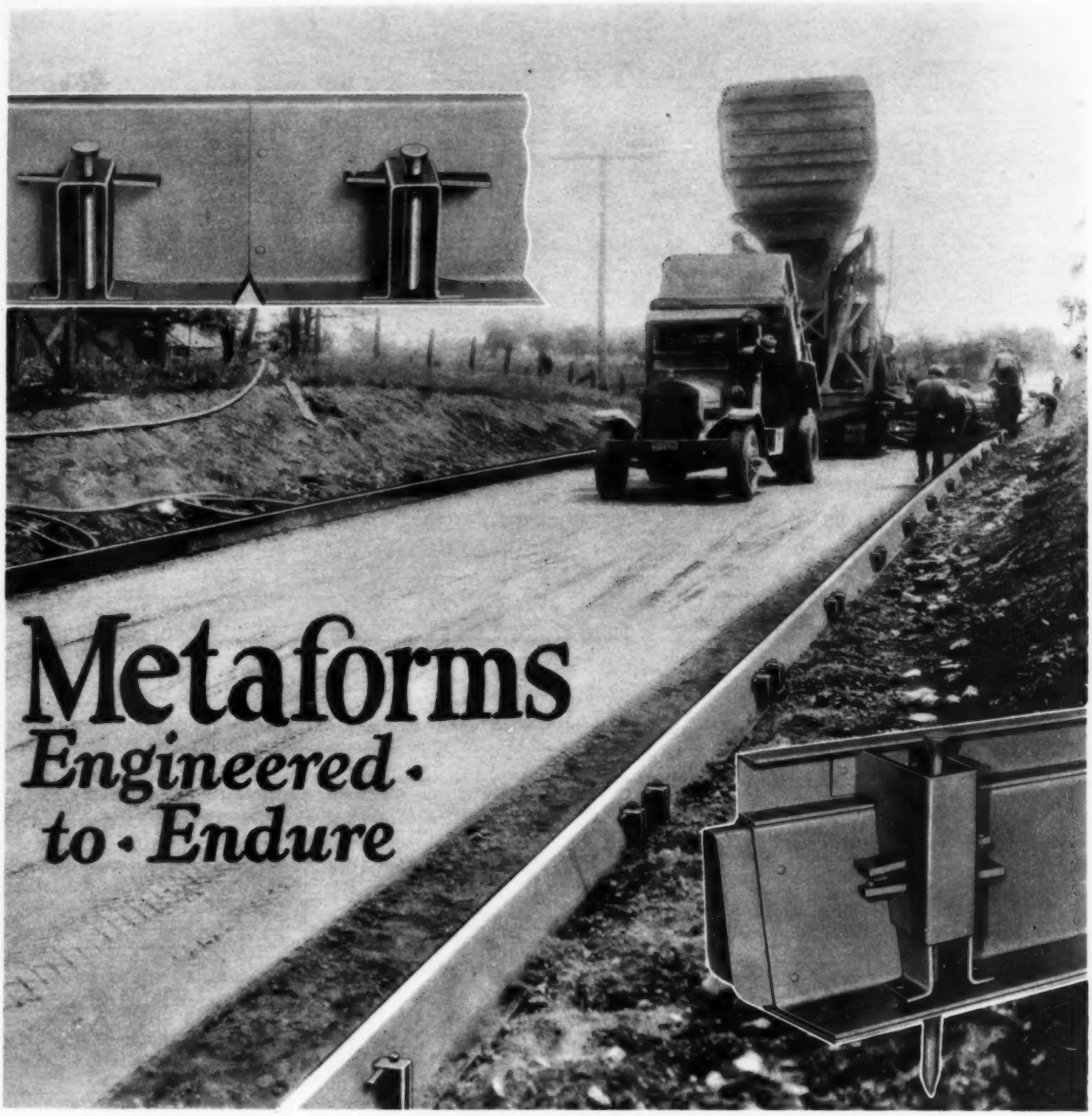
New York	Chicago	Philadelphia
St. Louis	Minneapolis	Hartford
Detroit	Cleveland	Boston
Buffalo	Columbus	Milwaukee
Providence	Syracuse	Birmingham
Lebanon	Toledo	Cincinnati
Baltimore	Youngstown	Bethlehem
Rochester		Portland, Me.

THE BARRETT COMPANY, Ltd.
Montreal Toronto Winnipeg Vancouver

IT IS as unsound economically to build too well as to build not well enough. Heavy-traffic roads at heavy-traffic prices on light-traffic routes not only waste taxpayers' money but also waste time, for the high-priced road usually has to be waited for.

Tarvia roads are always economical for they never need be over-built or under-built. There is a right type and strength Tarvia road—smooth, easy-riding and skid-safe—for every traffic requirement. And the Tarvia laid today for light traffic will serve as a foundation for stronger Tarvia pavement as traffic needs increase.

Tarvia is made by The Barrett Company, America's oldest and most experienced manufacturer of coal-tar road-building materials. All of Barrett's unmatched facilities—manufacturing skill, distributing equipment and paving experience—are available to road engineers and highway officials through the Tarvia field man. 'Phone, wire or write our nearest office.



The Price You Can Afford To Pay for a Road Rail (side form) depends upon:

1. **The cost of laying rail per foot.**
2. **The cost of stripping rail per foot.**
3. **The cost of repairs per each 10 foot length of rail per square yard of pavement laid.**
4. **The life of the rail in actual miles of pavement laid with each 10 foot length of rail.**

That is the test of a road rail for any paving contractor.

Look over the illustrations of the Metaform Rail above. Note the rigid rail joint and the fact that it is kept tight and smooth without a loose coupling member.

See how easily the Lip Curb is secured in position ready to form the curb. Metaform Lip Curbs are held securely by the same stakes that hold the rails. Like Metaform Road Rails, it is the lowest cost Lip Curb per mile of use, and costs the least to place and strip.

Before you buy any rail at any price be sure to investigate the Metaform Rail.

Metal Forms Corporation
Milwaukee, Wis.

ALLIS-CHALMERS TRACTOR
MODEL "M"

One year ago Allis-Chalmers announced the big Model "L" with its many advancements in track-type tractor design. That was the biggest tractor news of 1932.

Now comes the big news for 1933 in the track-type tractor field — the A-C Model "M"—"the baby of the family", but with the same stamina and durability so outstanding in its big brothers — the "35" and "L". For example —

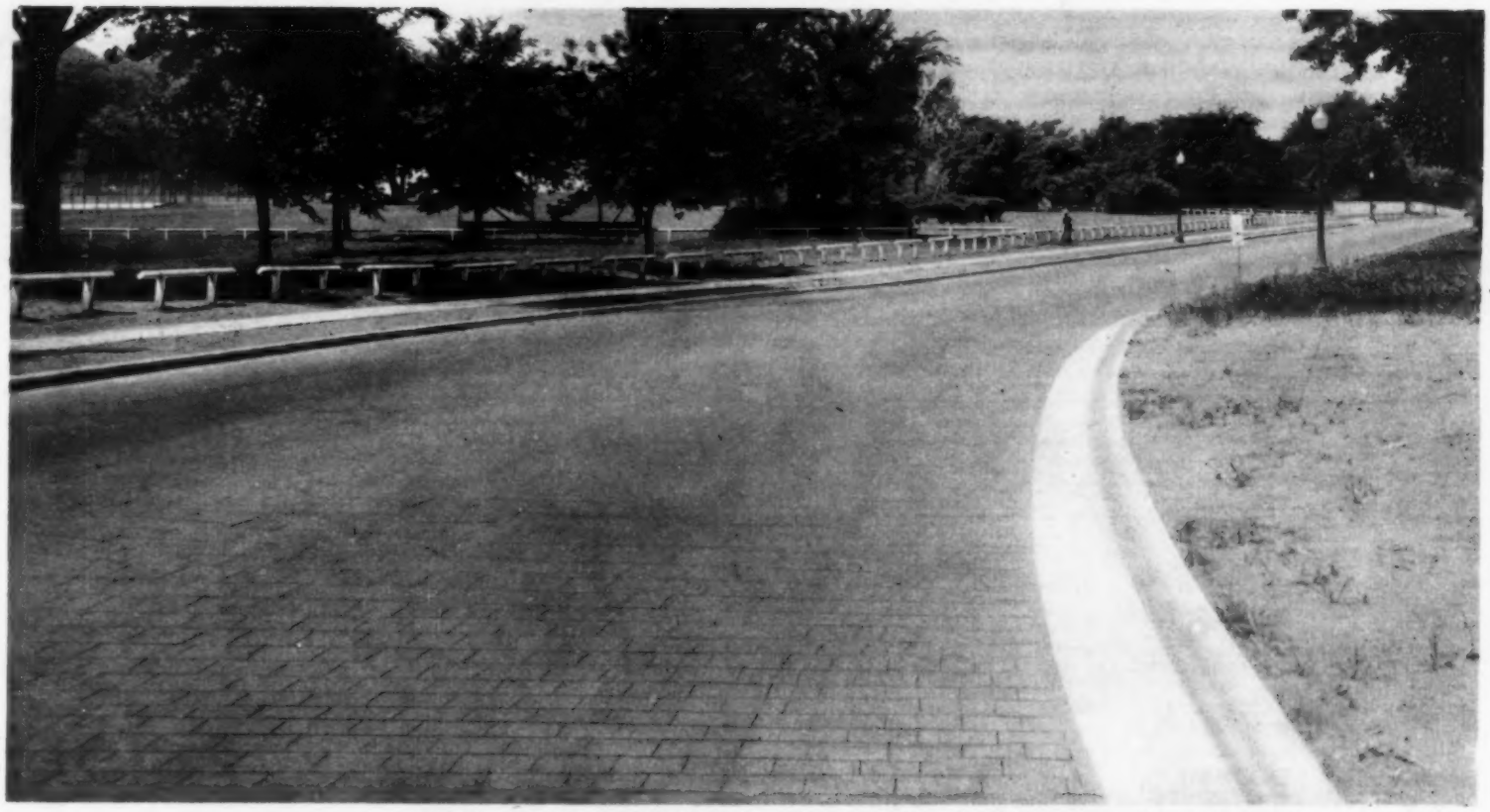
- Weighing only 6,200 pounds, the "M" delivers approximately 28 horsepower at the drawbar.
- The "M" has four forward speeds, ranging from 2.23 to 5.82 M.P.H.
- Although the most modern track-type tractor on the market, the "M" sells at a record low price for a tractor of this rating.

The Model "M" abounds with new and improved features. Years of experience in tractor engineering are back of it. Excellence of design and construction mark every detail of its make-up—unit construction; renewable cylinder sleeves; steering clutch control; 12" track shoes; high grade anti-friction bearings throughout.

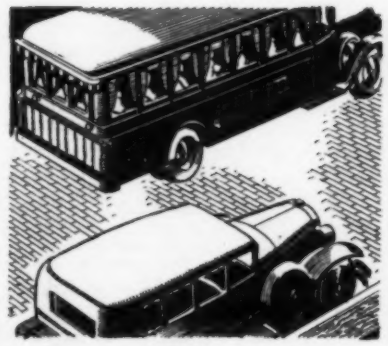
No less a sensation than its "big brother", the Model "L", the Model "M" will blaze a profitable trail to better earnings in 1933 for all who place their dependence upon it.

ALLIS-CHALMERS
TRACTOR DIVISION—MILWAUKEE, U. S. A.

WHERE FOUR MAIN ARTERIES OF TRAFFIC UNITE ON BRICK



Fifth Avenue at Riverside Park, Moline, Illinois—U. S. Route 32, State Route 7, State Route 80 and State Route 3.



TRAFFIC counts show an average flow of 1,000 vehicles per hour over this new pavement at Moline, Illinois, which is surfaced with modern vitrified brick. Four main arteries of traffic unite on brick over this exceptionally busy thoroughfare. ◙ Chiefly interesting from a construction standpoint are the provisions for drainage, requiring the installation of 76 catch basins and thousands of feet of storm sewer, ranging in size from 8" to 96". All curbs were reinforced as a precaution against settlement. ◙ Another feature of this pavement is the method employed in the base construction to control and prevent cracks under the brick surface. For this purpose, concealed deformed longitudinal joints in the base were installed. ◙ Its sponsors can be justly proud of this Modern Brick-Surfaced Pavement, because it was built to endure far beyond the "normal expectancy" of ordinary road construction.

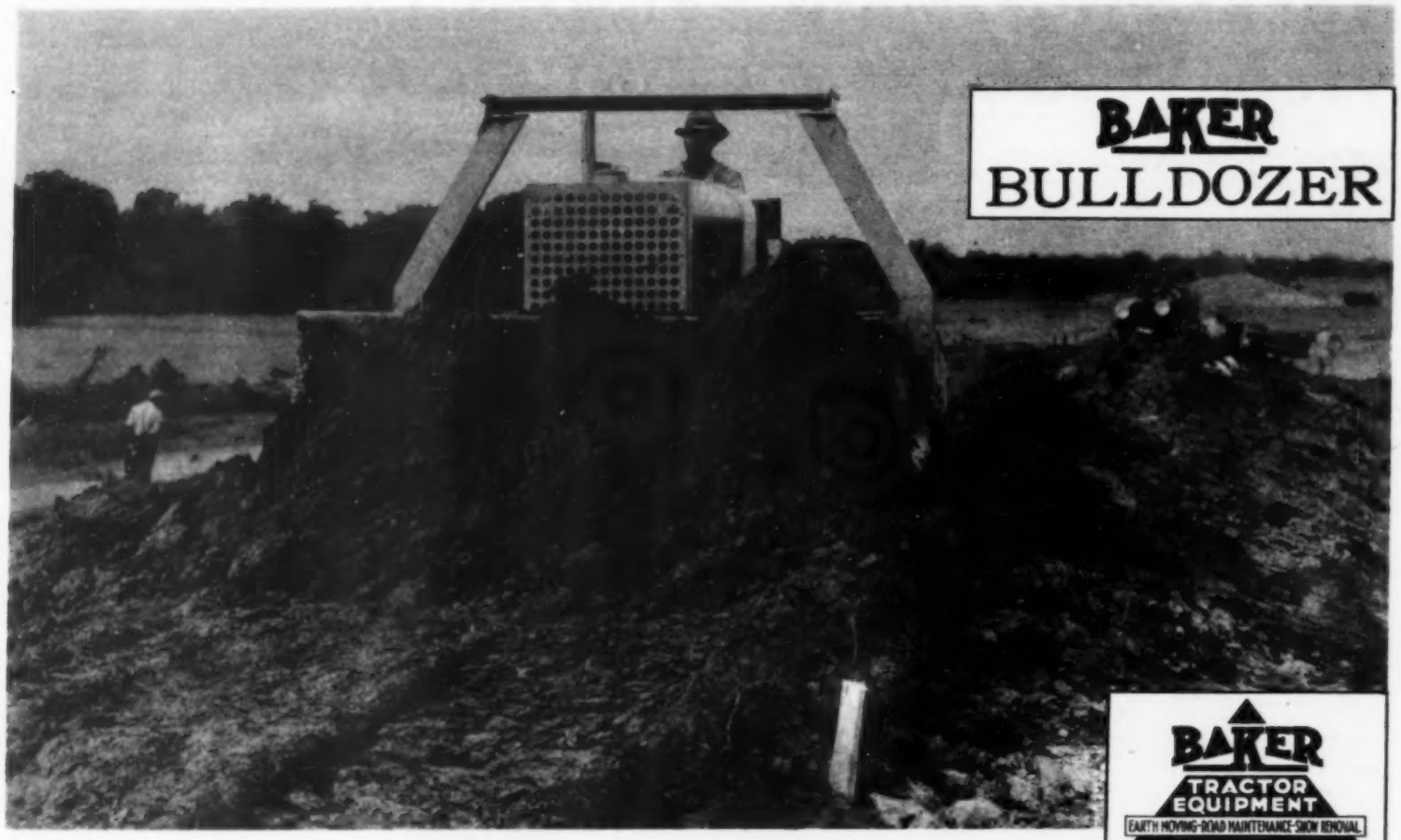
●

THE METROPOLITAN PAVING BRICK CO.
CANTON, OHIO

Manufacturers of Metro Canton, Bessemer, Olean, and Cleveland Paving Block • Architectural Face Brick • Structural Clay Tile • Metro Trickling Filter Flooring •

BRICK PAVEMENTS

Tune in on the Good Roads Program . . . Monday evenings at 8 p. m. over WTAM (Cleveland)



BAKER BULLDOZERS cut "bulldozing" expense on levee, dam, reservoir and highway construction. Easy on the tractor, they relieve you of huge tractor repair costs. Perfectly balanced—clear draw-bar—twin-cylinder hydraulic operation—quick, smooth lift—perfect control—high lift—always ready for the toughest assignments. Contractors prefer Baker Bulldozers. Send for Bulldozer Bulletins and learn why.

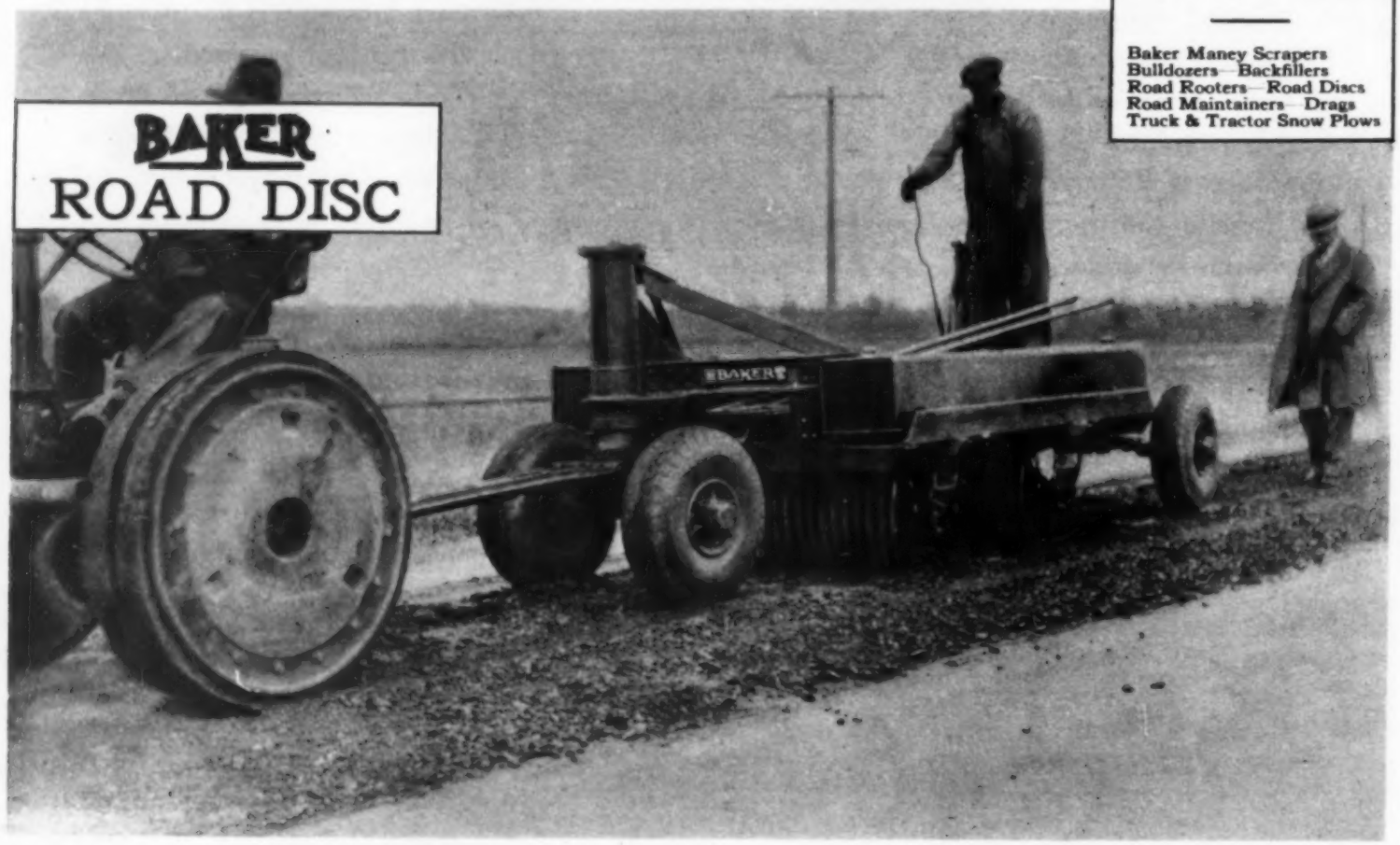
THE BAKER ROAD DISC, with hand hydraulic control, is the new low-cost method of maintaining oiled-earth, oiled-gravel and "re-tread" roads. No other machine can do the work it does. It cuts up the surface uniformly in small bits without disturbing the road base. It removes "chuck holes" and "washboard" surfaces. It mixes aggregate on "re-tread" roads. Send for Bulletin 521—interesting to every road official.

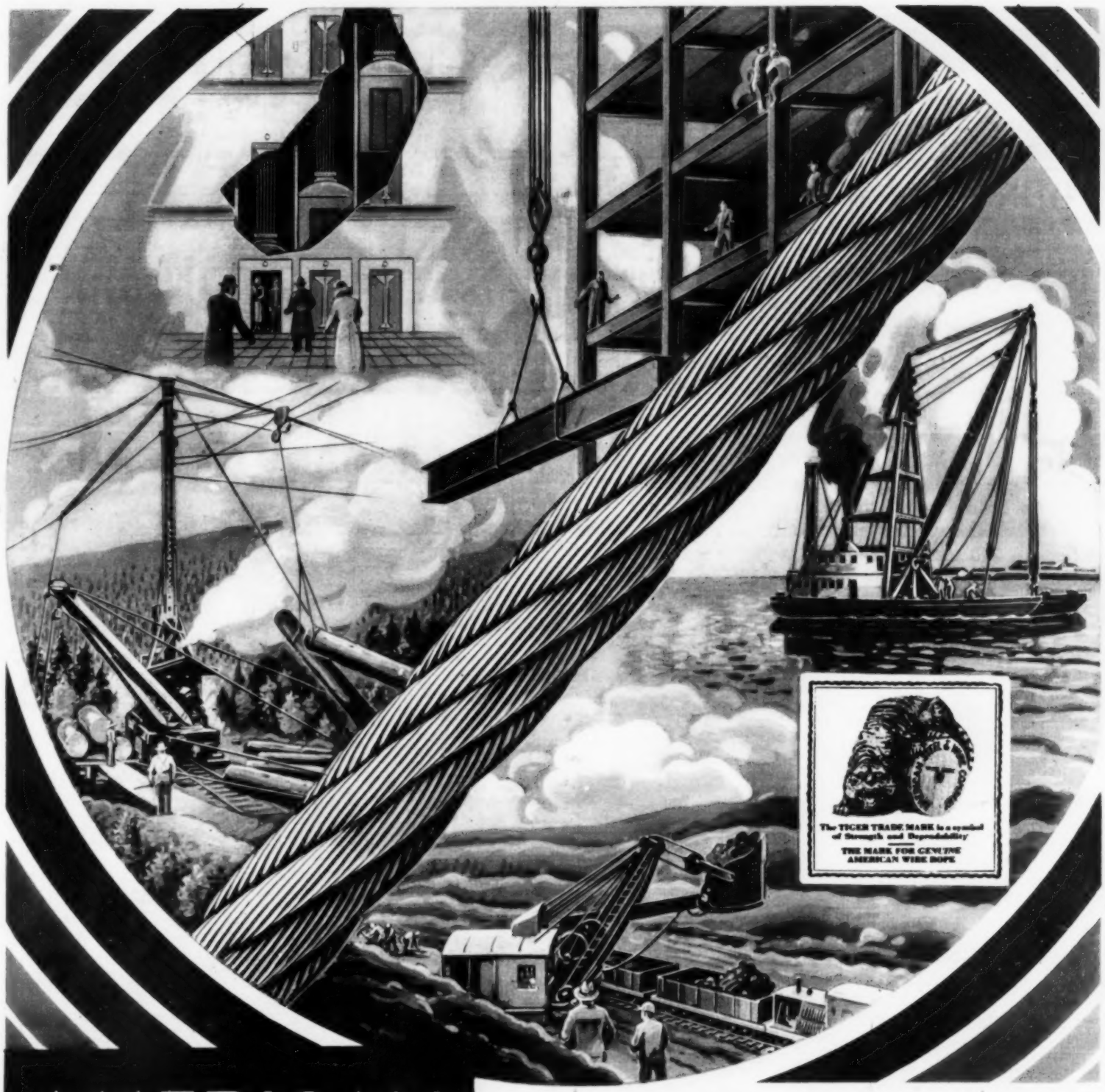
BAKER
TRACTOR EQUIPMENT
EARTH MOVING-ROAD MAINTENANCE-SNOW REMOVAL

Leads The Way To Low-Cost Grading And Road Maintenance.

Baker Maney Scrapers
Bulldozers—Backfillers
Road Rooters—Road Discs
Road Maintainers—Drags
Truck & Tractor Snow Plows

The Baker Mfg. Co., 568 Stanford Ave., Springfield, Ill.





AMERICAN
STEEL & WIRE COMPANY
WIRE ROPE

Lifting the Loads of the World

Wherever there is work to be done—oil to be drilled, logs to be hauled, materials to be hoisted, pipe to be laid—American Steel & Wire Company Wire Rope bears the brunt of the job. Simply because operators know it is the safest, most dependable and economical answer to the wire rope question.

A size and type for every mechanical requirement. Our one hundred years' wire making experience can doubtless help you determine the best wire rope for your needs.

1831 — MORE THAN 100 YEARS of PROGRESS IN WIRE MAKING — 1933

AMERICAN STEEL & WIRE COMPANY

208 South La Salle Street, Chicago
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SUBSIDIARY OF UNITED STATES STEEL CORPORATION
AND ALL PRINCIPAL CITIES

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* Each One Means Low Costs On Its Job

MIXING • MOVING • PUMPING

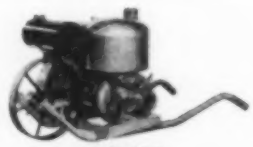
The right Rex equipment in the right spot

There's a spot in the construction business where each Rex Unit will exactly fit. The right equipment in the right spot will mean lower costs in this year when low costs mean everything. From the 3½-foot Tilter to the 5-yard Moto-Mixer, every Rex Mixer finds a lot of spots where it makes up a part of the lowest cost method of doing the job. From the simplest diaphragm to the Pumpcrete—the new concrete pump—every Rex Pump means low cost on its job. From a simple elevator to the complete concrete factory, Rex Handling Equipment will move material at lowest costs.

Look over this Rex Line—check the coupon and return it for complete information that will enable you to pick your spots . . .

CHAIN BELT CO., 1664 W. Bruce St., Milwaukee, Wis.
Name.....
Firm Name..... *Address*.....
City..... *State*.....
Please send me information.

JOB MIXERS
☐ 3½ Tilter
☐ 5-S ☐ 10-S
☐ 7-S ☐ 14-S



PUMPS
☐ 2"-Speed Primer ☐ Diaphragms
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☐ 4"-Speed Primer
☐ 6"-Speed Primer ☐ Road Pumps

HANDLING
☐ Belt Idlers
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PLASTER AND MORTAR MIXERS
☐ "6" Plaster Mixer
☐ "11" Plaster Mixer
☐ Cold Patch Mixer
☐ Saw Rigs

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☐ 28-S ☐ 56-S ☐ 84-S
☐ **27-E PAVER**

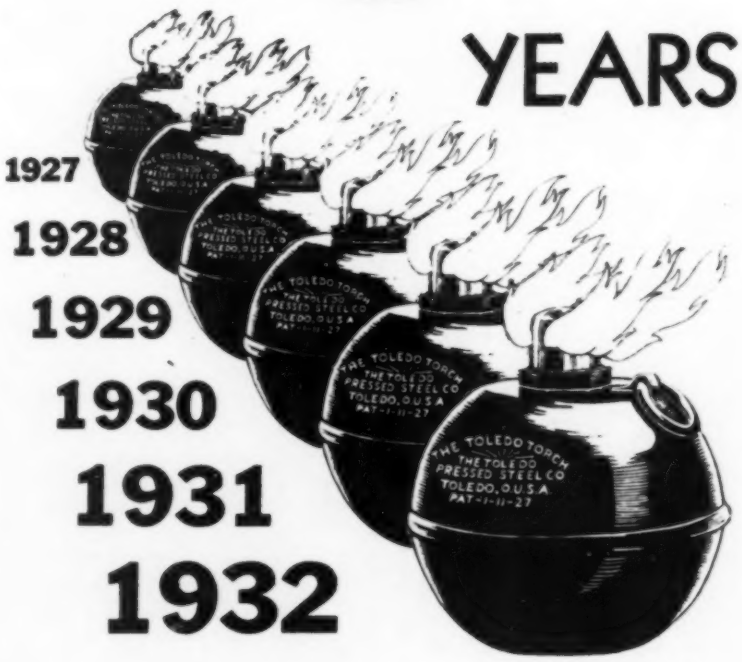
MOTO-MIXERS
☐ 1-Yard ☐ 3-Yard
☐ 1½-Yard ☐ 4-Yard
☐ 2-Yard ☐ 5-Yard

REX CONSTRUCTION EQUIPMENT

CHAIN BELT COMPANY
1664 West Bruce St., Milwaukee, Wis.

TOLEDO TORCHES

have successfully withstood the tests of time and all kinds of service for 6 YEARS



As the TOLEDO TORCH goes into its seventh year of ever increasing popularity, it is still without an equal for real dependability of performance and economy of operation « « « « «

It's the world's best safety light

USE THE TOLEDO TORCH AND OTHER SIGNAL MEANS SAFETY

The Toledo Pressed Steel Co.
TOLEDO OHIO

Save with Steel

HELTZEL

MORE-AND-MORE

Contractors and Engineers are depending on Heltzel Equipment to see them successfully

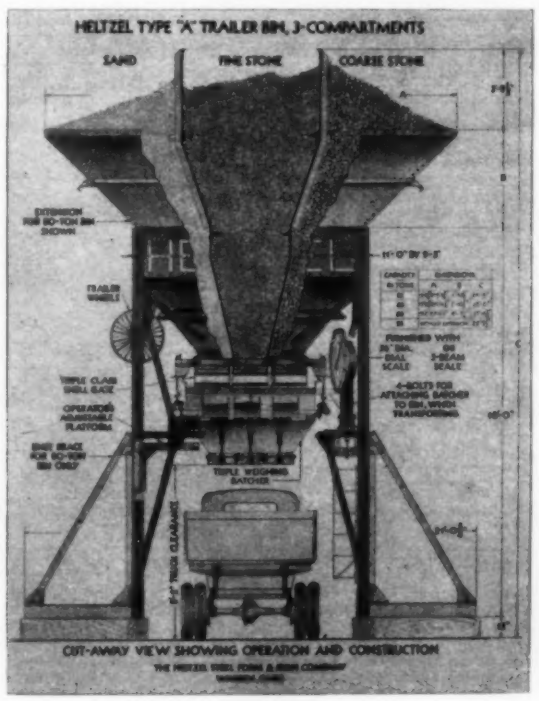
★THROUGH—1933★

HELTZEL PRODUCTS

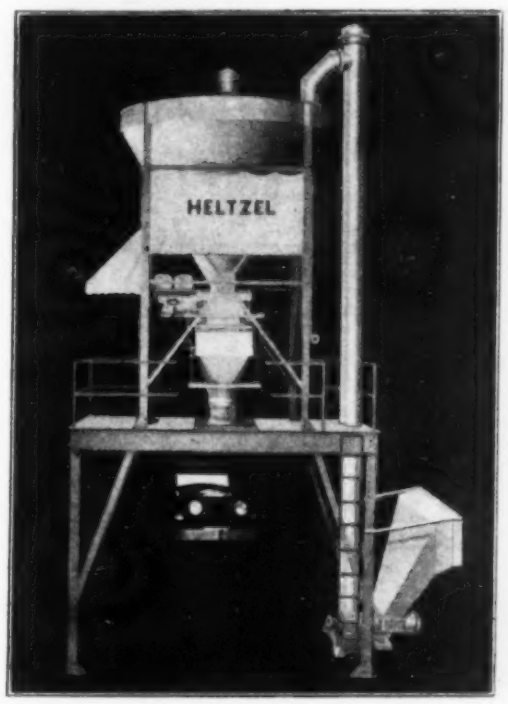
STEEL FORMS — For building Roads, Curb, Gutter and Sidewalks. STEEL BINS — Portable Batching Plants, Cement Bins, Central Mixing Plants, Rectangular, Square or Circular Bolted Bins, Batchers and Scales, Mechanical Spreader and Surfacer, Road Joint Installing Machines, Finishing Tools and Miscellaneous Equipment. Special Forms for Manhole, Sewer and Tunnel.

HELTZEL STEEL PORTABLE BINS

for Handling and Batching Concrete Aggregates



Heltzel 26 to 180 ton Batching Plants



Heltzel 50 to 335 bbl. Bulk Cement Plants

●

It pays — To protect your job with genuine —Heltzel Steel Road Forms.

★

More contractors purchased Heltzel Equipment in 1932 than in any previous years.

THE HELTZEL STEEL FORM & IRON CO., WARREN, OHIO

1933 ROAD SHOW—BOOTH NO. 211

Write for descriptive pamphlet

Little Pieces mean *more* Profit

It's fun for the crowd — folks get a great kick out of watching the shovel handle a big rock. But — it's more fun for you when the shovel can keep on scooping up the little fellows.

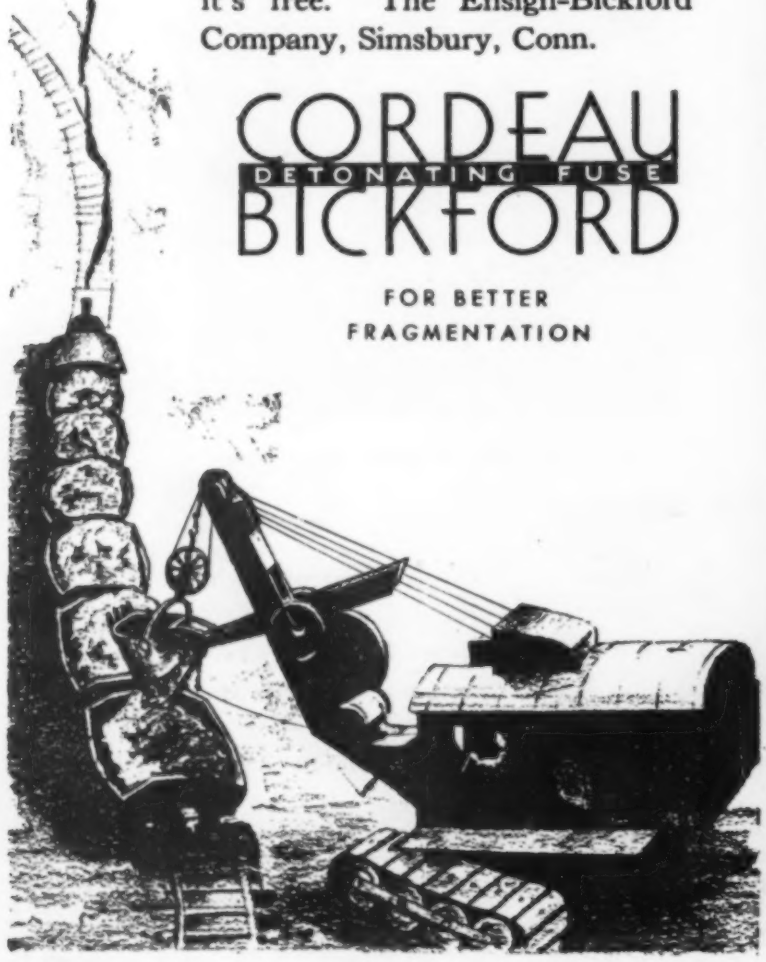
Profits in excavation work — whether quarry, highway, dam or foundation — go back to the blasting. It's easier and it costs less to move the rock when properly fragmented. And you can get better fragmentation if using Cordeau-Bickford Detonating Fuse.

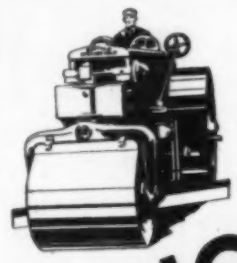
You can save time in loading, reduce the hazard and obtain more work from your explosives — with Cordeau.

Write for the Cordeau book — it's free. The Ensign-Bickford Company, Simsbury, Conn.

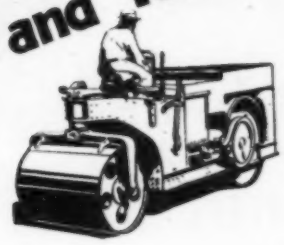
CORDEAU
DETONATING FUSE
BICKFORD

FOR BETTER
FRAGMENTATION





BUFFALO-SPRINGFIELD
Three Wheel and Tandem



BUFFALO-SPRINGFIELD'S complete range of models in both three-wheel and tandem rollers permits the purchaser to select a machine properly powered, designed, and speeded for his work.

Full details will be furnished on request.

THE BUFFALO-SPRINGFIELD ROLLER COMPANY
Springfield, Ohio

Fulton Quality

TARPAULINS
WINDBREAKS
& TENTS

The FULTON LINE of Tarpaulins, Windbreaks, Tents, Burlap, Roll Duck, etc., is produced by mass-production and cost-saving methods, which assure high quality at reasonable prices. These products afford complete protection for your property and workmen against cold and wet weather. They help you speed up work, reduce costs and make profits for you. Write today for samples and prices.

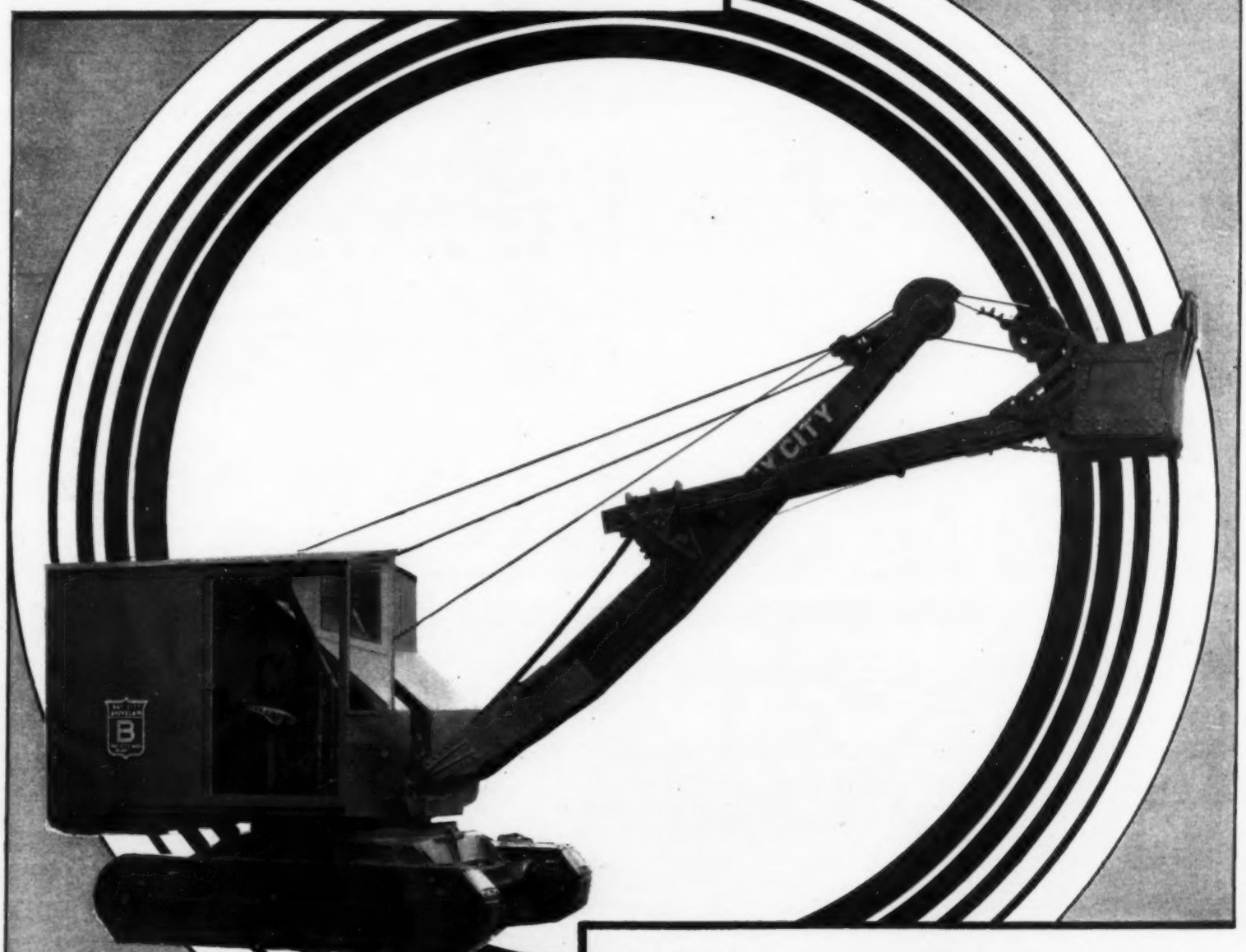
Fulton Bag & Cotton Mills
Manufacturers Since 1870
ATLANTA ST. LOUIS DALLAS
MINNEAPOLIS BROOKLYN NEW ORLEANS KANSAS CITY, KAN

Give yourself a CHANCE on present day bids and costs to outbid your competitor!

Meet low bids at a profit by replacing old and obsolete equipment with modern, dependable BAY-CITY convertible shovels and cranes and get every advantage of lowest operating costs.

Write for facts before bidding on your next job.

Six Sizes
⅜ to One Yard
3 to 18 Ton Capacity



ADVANTAGES

Unit Base Castings.
Chain Crowd
Frictionless Bearings.
Helical Gears.
Alloy Shafting.
Balanced Design.
E-Z Clutch Control.
Full Measure Buckets.
Fastest Speeds.
Unexcelled Steering—with car in any position

Get low cost construction!

One "sick" machine will slow the entire job and maybe run it in the "red". It is not enough to use modern haulage equipment for if it "loafs" at half capacity behind an old or obsolete shovel you have only increased your construction costs. Keep your equipment moving—make it pay dividends by carrying "pay loads"—loaded to full capacity with a modern BAY-CITY shovel or crane.

BAY CITY shovels, cranes and dredges, in operation all over the country have established a reputation of unquestioned quality in design and construction. They are known "money savers"—economical and efficient in operation and they deliver a full day's work. There is no better value in modern shovel equipment. *Write for bulletins and literature.*

BAY CITY SHOVELS, Inc.

General Office and Factory
Bay City, Mich.

Eastern Office
Roselle Park, N. J.

BAY-CITY SHOVELS

They're Moving Dirt for 4.95¢ per Cu. Yd. » » » » » » » in Missouri

The song of the DIRTMOVER is **cheap dirt**—lower and lower cost per yard.

Martin Wunderlich Construction Company, Jefferson City, Mo., were up to their ears in tough red clay and Missouri gumbo—a road grading job—and used their Blaw-Knox (Ateco) Hydraulic DIRTMOVER to do the work at 4.95¢ per cubic yard.

the low cost **DIRTMOVER**

At that rate—it don't take long to pay for equipment—and make a profit while paying for it.

Yardage costs such as this, **and lower,** are a matter of common record. We would like to tell you about contractors who are making real money out of all kinds of dirt moving jobs.

May we send you a copy of Catalog No. 1372 —"Blaw-Knox (Ateco) Dirt Moving Equipment"?

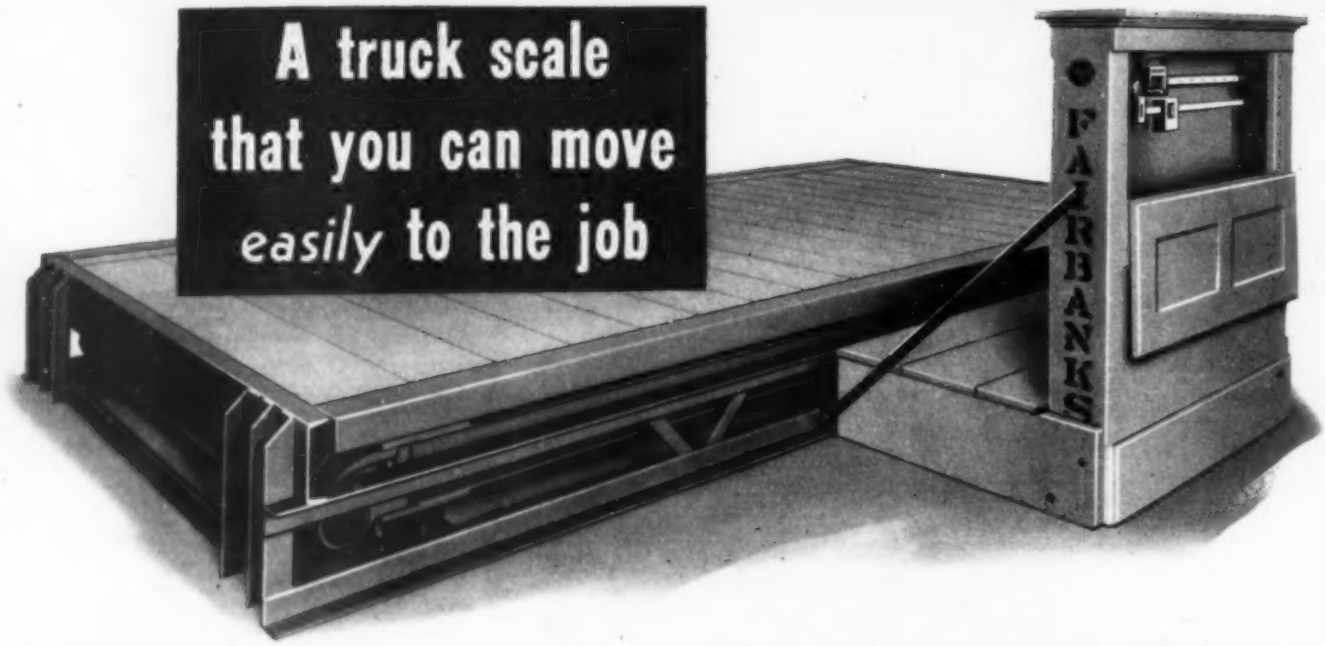
See the Blaw-Knox Exhibit at the Road Show—Detroit, Booth 145.

BLAW-KNOX COMPANY
Farmer's Bank Building, Pittsburgh, Pa.
Offices and Representatives in Principal Cities

BLAW-KNOX

Dirtmovers Bulldozers Scarifiers Tamping Rollers Wagon Graders Clamshell Buckets Dragline Buckets

A truck scale that you can move *easily* to the job



AGAIN, Fairbanks, by closely watching the needs of the industries it serves, produces a scale which fits *exactly* the requirements of contractors.

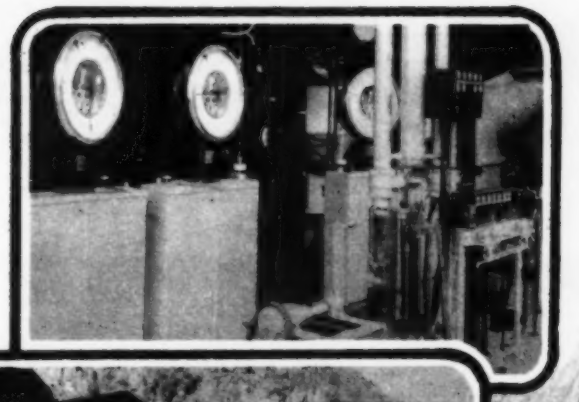
For checking receipt and disbursal of aggregates—for weighing aggregates as a basis of payment for the job (a growing practice in many states)—Fairbanks has produced a self-contained Truck Scale *which can quickly and easily be dis-assembled and transported from job to job.* On a paving project, for example, this scale can be advanced along the job with the mixers or pavers.

Full descriptive literature may be obtained by writing nearest branch or Fairbanks, Morse and Co., 900 S. Wabash Ave., Chicago. And 40 Principal Cities—a service station at each house.

Fairbanks Scales

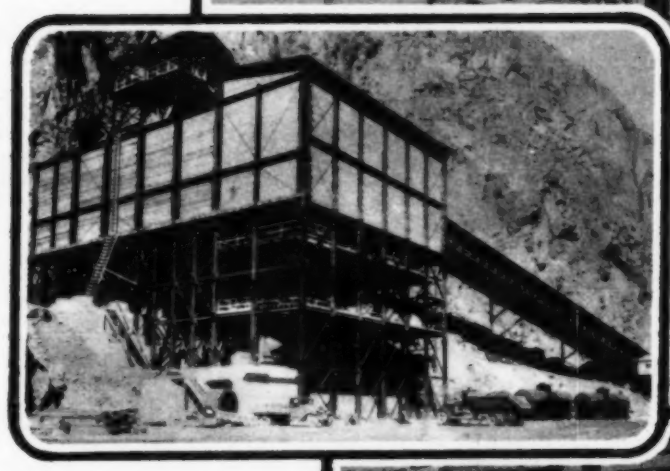
FAIRBANKS SCALES PREFERRED THE WORLD OVER

5544-8A31.12



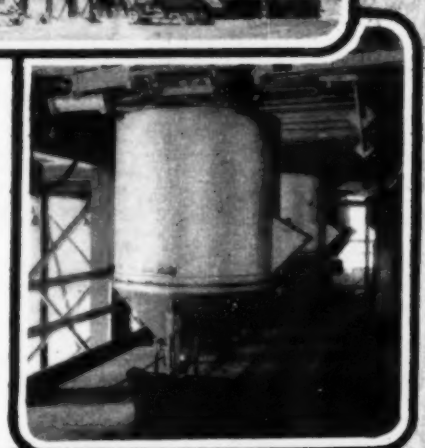
OPERATING STATION

Hoover Dam Low Level Mixing Plant



HOOVER DAM LOW LEVEL MIXING PLANT

Maximum capacity about three train loads of concrete per day



AUTOMATIC WEIGHING AGGREGATE BATCHERS

Hoover Dam Low Level Mixing Plant

MADDEN DAM MIXING PLANT

Panama Canal Zone

LARGE READY MIXED CONCRETE PLANT

T. L. Herbert & Sons, Nashville, Tenn.

JOHNSON Bins and Batchers are meeting modern specifications for scientifically controlled concrete on both large and small concrete jobs where correct proportioning and mixing is increasing in importance.

JOHNSON Auto-Weight Batchers in the main Hoover Dam Mixing Plant are fulfilling the most rigid and elaborate specifications ever written for concrete work.

Full details gladly furnished for jobs warranting such equipment.

THE C. S. JOHNSON COMPANY

CHAMPAIGN, ILLINOIS

CHANGE...CHANGE

McGRAW-HILL

New York · Boston · Philadelphia · Washington · Greenville

Business men, industrialists and engineers regularly read the McGraw-Hill Publications. More than 3,000,000 use McGraw-Hill books and magazines in their business.

Radio Retailing
Food Industries
Chemical & Metallurgical Engineering
Electrical World
Electrical Merchandising
Electrical West
Electronics

CHANGE...CHANGE

See what is happening to your customers

Business men who are resting on their selling oars, confident that past efforts have sewed up their markets, need only to look at the following facts to have their complacency disturbed.

In the past year somewhere between 35% and 69%* of the men with buying authority in industry either changed their jobs or their connections or were new men in new executive or managerial jobs. Hundreds of thousands of changes—each one a "new name on the door." New prospects to be converted into customers. New sales jobs on which your salesmen must start from scratch. A vast parade of men marching through industry. Yes, the old order changeth—the old giving place to the new.

Once you look at industry from that viewpoint you will realize why it is impossible to saddle the whole selling load on salesmen alone except at tremendous cost. And why should you when low-cost industrial advertising can be employed to back up (and buck up!) your salesmen—to open doors to them—to build good-will and confidence in your product, break down prejudices, make prospects want to see your salesmen and hear their story—leaving your men free to relate your product to the specific needs of the prospect and to get the order.

Today with competition keener than ever—with many men in many jobs to be sold—with many changes in personnel taking place—your salesmen need that backing of advertising more than they ever needed it before. And you need that low sales cost which only a well balanced program can give you.

Give it to them! And to yourself! Don't say you can't afford it. For through the McGraw-Hill publications, where you pay to reach *only* your logical prospects, you can do a thorough advertising job to industry on a surprisingly small budget.

*The percentage figures quoted above are based on corrections made in McGraw-Hill subscription lists due to changes of jobs, removals on account of death, discharges, resignations, promotions, etc., and also the addition of new men in jobs new to them, made vacant by the changes mentioned.

PUBLISHING COMPANY, Inc.

Cleveland · Detroit · Chicago · St. Louis · San Francisco · Los Angeles · London

American Machinist
Product Engineering

Engineering News-Record
Construction Methods

Engineering and Mining Journal
(Domestic and Export Editions)

Metal and Mineral Markets
Coal Age

Transit Journal
Bus Transportation

Aviation
Textile World

Factory and Industrial Management
Maintenance Engineering
Power

The Business Week

The ideal book
for the construction engineer

Here is a book with a new idea—one handbook of 900 pages of practical, up-to-date information, useful reference data, specific facts, definite methods, essential formulas in:

—civil engineering
—mechanical engineering
—electrical engineering
—engineering mathematics
—engineering fundamentals

The most frequently needed and essential engineering information in the form in which you want it and can use it—one handy book—clear, concise, complete, convenient.

GENERAL ENGINEERING HANDBOOK

Editor-in-Chief: CHARLES EDWARD O'ROURKE, Assistant Professor of Structural Engineering, Cornell University. Assisted by a staff of 29 specialists. **900 pages, 5x7¾, flexible, $4.00.**

Read what these users say:

"Consider it a very good book. Splendid civil engineering section with mechanical and electrical engineering information most likely to be used by a civil engineer in certain classes of work."

—EDWIN O. SLATER,
Civil and Mining Engineer, Miami Copper Company.

"A valuable asset to an engineering library."

—W. B. CAUTHORN,
City Engineer, Columbia, Mo.

"I find this publication more adapted to desk use than any other handbook, as statements of problems are concise and it is not necessary to wade through elementary matter."

—GEORGE W. PERRY,
Constructing Engineer, Philadelphia Gas Works Co.

"I find O'Rourke's General Engineering Handbook gives me quite fully the information I wish in engineering problems."

—CHARLES H. GEARHART,
Architect.

"I am very much pleased with the new handbook and would not care to be without it as it gives much desired information in the one volume."

—DONALD E. YOUNG,
Civil Engineer; U. S. Engineers—C. of E

Essential data in ALL fields of engineering—Now made handy in ONE compact volume!

Mathematics—Mathematical Tables—Units, Weights, and Measures—Engineering Materials—Mechanics—Hydraulics—Graphic Statics—Stresses in Framed Structures—Steel and Timber Structures—Reinforced Concrete Structures—Foundations—Surveying, Mapping and Leveling—Railway Location and Earthwork—Highways—Water Supply—Water Power Plants—Sewerage and Sewage Disposal—Machine Elements—Heat and Thermodynamics—Steam Power Plant Equipment—Internal Combustion Engines—Pumps and Compressors—Heating and Ventilating—Mechanical Refrigeration—Mechanical Power Transmission—Welding—Electricity and Magnetism—Electrical Measurements—Electrical Machinery—Electric Power Equipment—Electric Power Transmission and Distribution.

See it 10 days free—Send this coupon

McGRAW-HILL FREE EXAMINATION COUPON

McGraw-Hill Book Co., Inc., 330 West 42d Street, New York, N. Y.

Send me a copy of O'Rourke—GENERAL ENGINEERING HANDBOOK, $4.00, postpaid, for 10 days' free examination. I will return the book postpaid in 10 days or remit for it then.

Name .....

Address .....

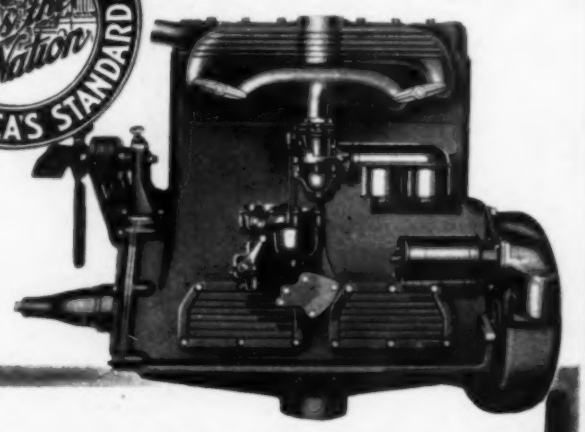
City and State .....

Occupation .....

Company .....

(Books sent for free examination to purchasers in U. S. and Canada only.)
C.M. 1-33

CONTINENTAL MOTORS — Powering a Nation — AMERICA'S STANDARD



Construction equipment, powered by Continental, always gives satisfactory, dependable and economical service. Performance and low operating costs are assured by the records of 3,500,000 Continental engines produced in the past 30 years.

SUCCESSFUL PERFORMANCE A.G.C.-A.E.C.

Continental's laboratory engineering facilities and data are at your disposal. We invite you to write.

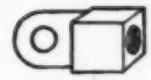
Visitors to the Highway and Building Show at Detroit, Jan. 16 to 20, are invited to visit our plant.

Continental Engines

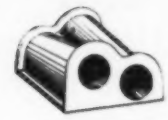
Continental Motors Corporation, Detroit • Muskegon

MARION Contractors Specialties

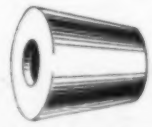
Hex Coupling
For making reinforcing continuous, for use as an insert, for form ties.



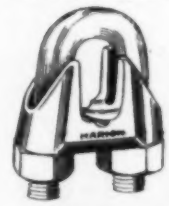
Form Tightener
An efficient tightener for wire form ties.



Tank Lugs
Of strong, tough, shock-resisting Marion Certified Malleable Iron.



Form Spreader
Used with Hex Coupling.



Cable Clips
Persistent grip, steel U-bolts with cold rolled threads.

Washers
Shock-proof malleable castings for bolts, tie-rods, braces

Investigate these cost-cutters and time-savers *before* you put in your bids. Send for circular showing how these specialties are used in all types of construction work.

MARION MALLEABLE IRON WORKS
913 Miller Avenue, Marion, Indiana

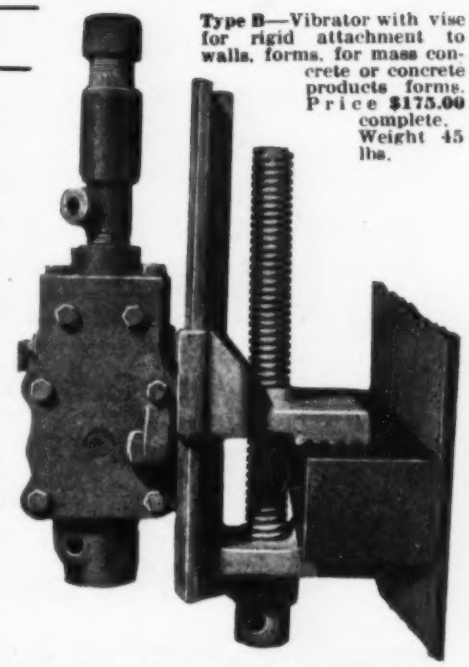
"Better placement for less cost—"

MUNSELL AIR DRIVEN VIBRATORS

Type A—Portable Vibrator for use on flat slabs, beams, girders. Attachments interchangeable with Type B. Price **$150.00** complete. Weight 35 lbs.

Designed by an engineer

▲ The use of vibrators to make good concrete better saves time and money. But your Vibrator should be designed for its job — not just "adapted". Munsell Vibrators, *designed by an engineer,* embody all the good features of other apparatus plus speed or frequency entirely under the *control* of the operator. This means complete control for concrete of various consistencies — a most important point. Lightweight, compact, rugged, will operate in any position. Used on George Washington Bridge, Osage River Dam, Kill Van Kull Bridge, Newark, New Jersey Subway, Market St. Subway and Bridge (Phila.) Note two models—here—Write for "Specification for Placement of Concrete by Mechanical Vibration".



Type B—Vibrator with vise for rigid attachment to walls, forms, for mass concrete or concrete products forms. Price **$175.00** complete. Weight 45 lbs.

MUNSELL CONCRETE VIBRATORS

567 Newark Street — *Hoboken, N. J.*

The New Blaw-Knox TRUKMIXER is the last word in all around efficiency, long life and low cost » » »

This is the unit that enables contractors, building supply dealers and ready mixed concrete plants to make worth while profits even with limited use. The Blaw-Knox TRUKMIXER is built to serve the average contractors needs and is so economical that it is a paying investment even in a dull season. The TRUKMIXER is made to last; maintenance costs are practically eliminated.

A Blaw-Knox engineer can prove to you with figures taken from your own local conditions and set-up, that a TRUKMIXER will be a profitable investment. Will you ask us for this demonstration even if you are only curious; there is no obligation involved.

The Blaw-Knox Improved TRUKMIXER is made in the following sizes:—

AS A MIXER—1, 1½, 2, 3, 4 and 5 cubic yard capacities.

AS AN AGITATOR—1, 2, 3, 4, 6 and 7 to 8 cubic yard capacities.

Phone—wire or write

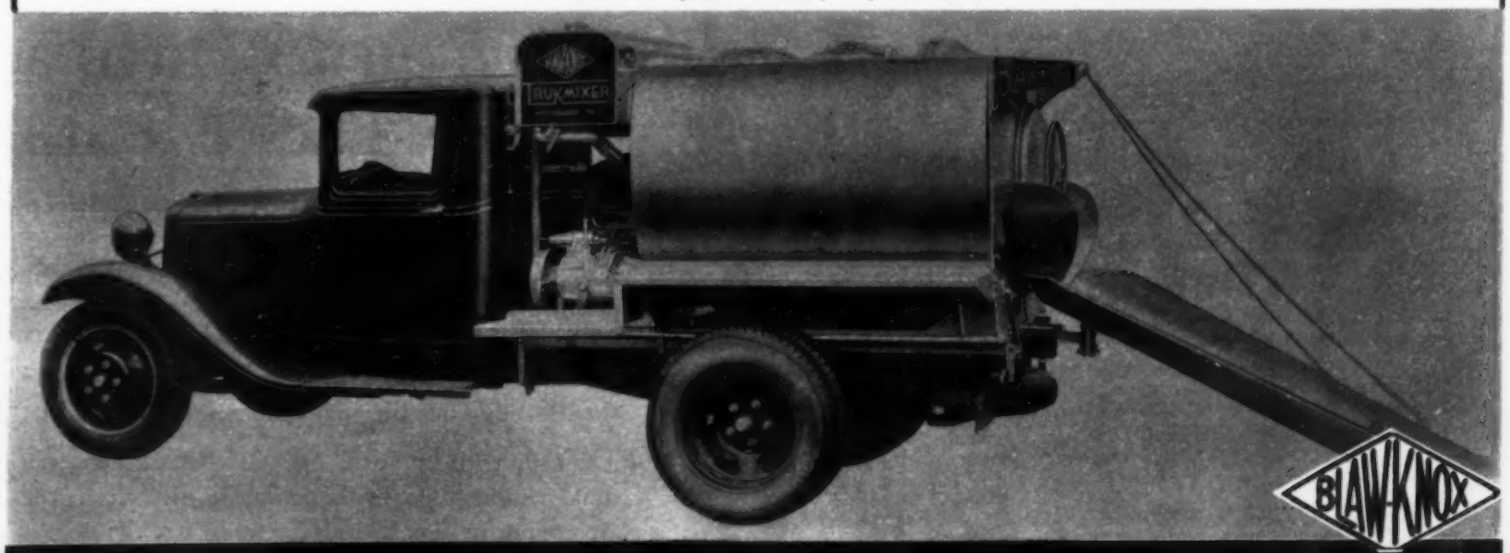
SEE THE BLAW-KNOX EXHIBIT AT THE ROAD SHOW

Booth No. 145

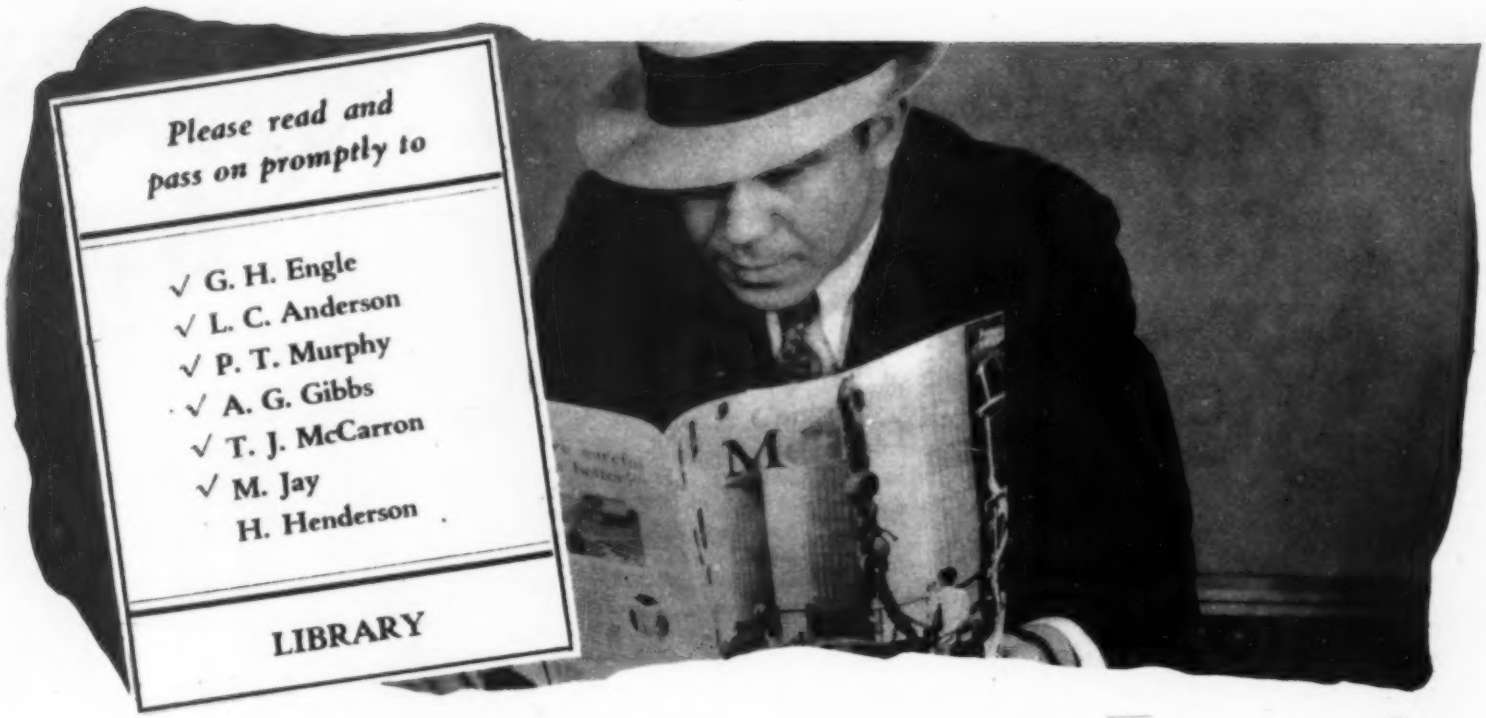
BLAW-KNOX COMPANY

FARMERS BANK BUILDING — PITTSBURGH, PA.

Offices and representatives in principal cities.



Road Forms . Batcherplants . Clamshell Buckets . Steel Forms for Concrete Construction . Bulk Cement Plants . Ready Mixed Concrete Plants . Truck Mixers . Dirtmovers . Wagon Graders . Tamping Rollers . Bulldozers . Scarifiers . . Concrete Buckets



He Was Seventh on the List!

Yet He Was Responsible For the Job

KEEP POSTED

Each month CONSTRUCTION METHODS brings you new ideas on:

—how to use old equipment in new ways.

—how to save money on the job.

—the pitfalls in bidding.

—new trends in construction practices.

"The chief has an idea he is saving money by having seven men read one copy of Construction Methods. Just how wrong he is, can best be told by relating an experience I had on the job we have just finished.

"Here it is:

"To complete the road building job I was on, it was necessary to use a scraper slightly larger than the one on the job. After 5 hours' delay a scraper was rented for $75 and the job completed.

"Ordinarily, such delay and extra expense is considered 'part of the business' but if I had seen the current issue of Construction Methods (which reached me 5 weeks later) I could have saved the delay and expense, by using the scraper idea you describe in this issue.

"I'm tired of having the copy reach me, weeks late, and with pages missing—all because someone 'on the list' thoughtlessly clipped the magazine. To stop all this, use the enclosed $1 to enter my name on your subscription list for the next months."

It Will Pay You to Have a Personal Copy Each Month

Think of the satisfaction—the convenience—of having your personal copy of Construction Methods sent direct to your home. You can sit down and read it from cover to cover while the ideas it brings you are new. Then after reading it, if you want to clip certain photographs, you can do so without penalizing some other person. In this way you can build up a valuable reference file that you can use on the job.

Don't continue to be just "one on the list" enter a personal subscription by attaching a $1. bill to the coupon and mailing it, today.

CONSTRUCTION METHODS
330 West 42d Street
New York City, N. Y.

Here's my dollar!
Send me the next 12 big issues of
CONSTRUCTION METHODS.

NAME .....

ADDRESS .....

CITY..... STATE.....

EMPLOYED BY.....

CONSTRUCTION METHODS

SEARCHLIGHT SECTION

EMPLOYMENT : BUSINESS : OPPORTUNITIES : EQUIPMENT—USED or RESALE

UNDISPLAYED—RATE PER WORD

Positions Wanted, 5 cents a word, minimum $1.00 an insertion, payable in advance. (*See ¶ on Box Numbers.*)

Positions Vacant and all other classifications 10 cents a word, minimum charge $2.00.

Proposals, 40 cents a line an insertion.

INFORMATION:

Box Numbers in care of New York, Chicago and San Francisco offices count 10 words additional in undisplayed ads.

Discount of 10% if one payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).

DISPLAYED—RATE PER INCH:

1 inch.....$6.00
2 to 3 inches..... 5.75 an inch
4 to 7 inches..... 5.50 an inch

Other spaces and contract rates on request.

An advertising inch is measured vertically on one column, 3 columns—30 inches—to a page.

COPY FOR NEW ADVERTISEMENTS RECEIVED UNTIL 10 A. M. THE 27TH OF THE MONTH FOR THE ISSUE OUT THE FOLLOWING MONTH C.M.

WEMLINGER

STEEL SHEET PILING
SOLD — RENTED — BOUGHT
"A NATION WIDE SERVICE"

NEW YORK 500 Fifth Ave. | CHICAGO 221 No. La Salle St. | PHILADELPHIA 1015 Chestnut St. | BOSTON 31 State St. | RICHMOND 1708-1722 Lewis St. | TAMPA 206 Madison St. | NEW ORLEANS 1105 Maritime Bldg. | HOUSTON 117 Eastwood St. | LOS ANGELES 2044 Santa Fe Ave.

CASH
IS AN ASSET

IDLE MACHINERY
IS A LIABILITY

ADVERTISE idle equipment in the Searchlight Section and turn it into

CASH

Write, Wire or 'Phone

Departmental Advertising Staff
Construction Methods
330 West 42d St., New York City

Large Surplus Plant

Send for list or call on us for anything in heavy construction.

MASON & HANGER COMPANY, INC.
Engineers-Contractors
500 Fifth Ave., New York

CONCRETE MIXERS

For immediate disposal, like new, one or two bag Concrete Mixers—equipped for State work—Available at rare bargain prices.

FS-104, Construction Methods
520 No. Michigan Ave., Chicago, Ill.

WANTED TO BUY
Structural Steel Building
covered with corrugated galvanized iron. Approximate dimensions 50x100x40 ft. high. Can use up to 80x150 ft., provided price is right.
HARTSVILLE OIL MILL
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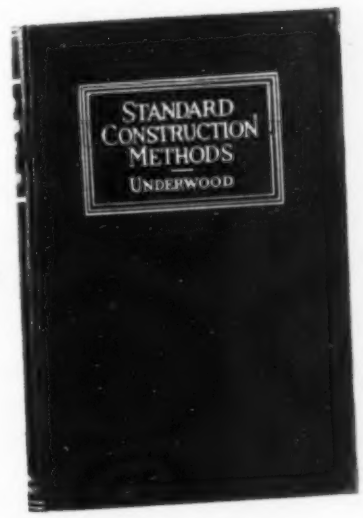

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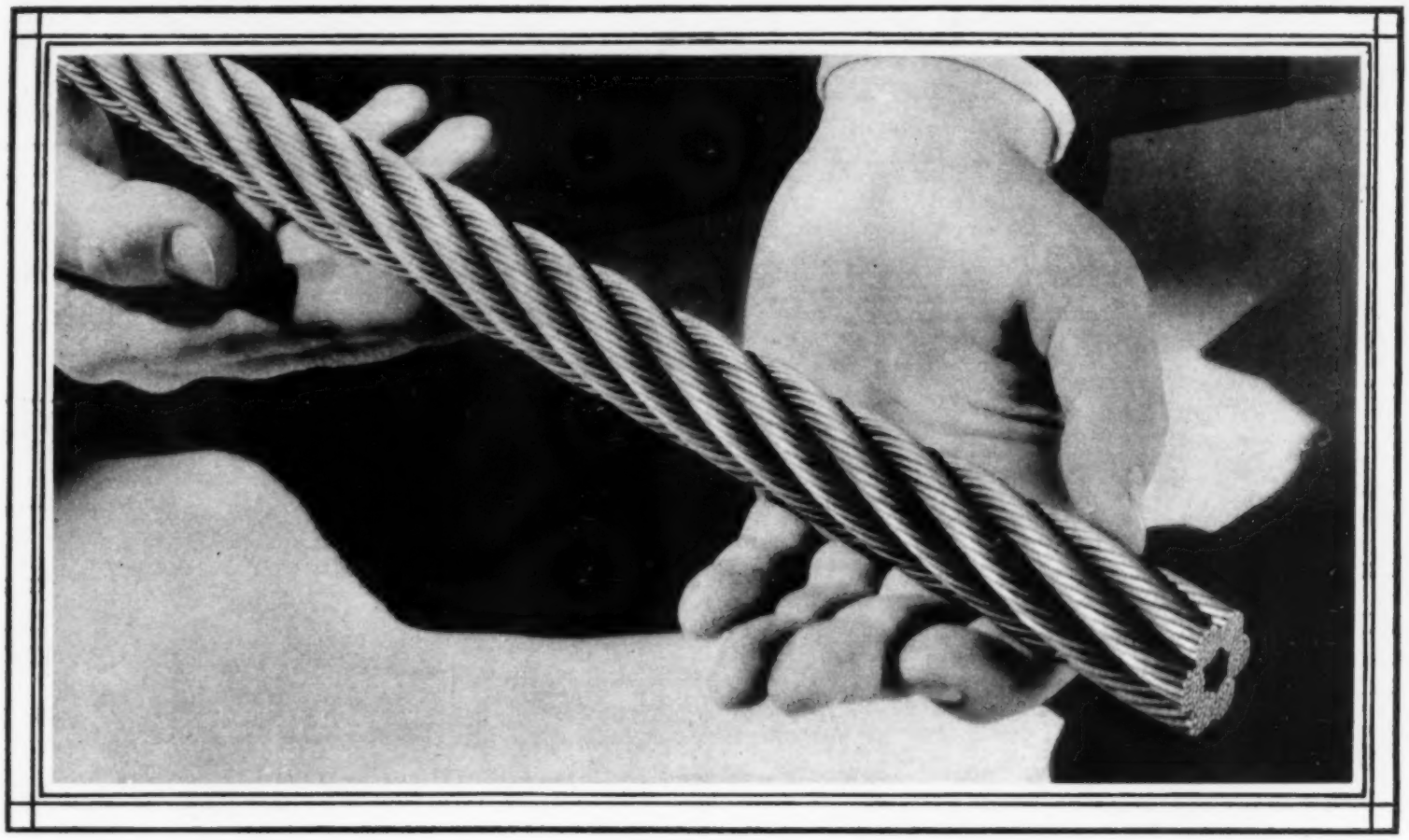

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